AMERICAN SURGICAL ASSOCIATION NUMBER

Vol. LXXX SEPTEMBER, 1924 No. 3

ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

Edited by

LEWIS STEPHEN PILCHER, M.D., LL.D.

of New York

With the Association of

JAMES TAFT PILCHER, B.A., M.D.

and the Collaboration of

W. SAMPSON HANDLEY, M.S., M.D., F.R.C.S.

of London

J. B. LIPPINCOTT COMPANY, PUBLISHERS

MONTREAL PHILADELPHIA LONDON

Entered at the Post-Office at Philadelphia and admitted for transmission through the mails at second-class rates.
Price, $10.00 a year.

ANNALS of SURGERY

VOL. LXXX SEPTEMBER, 1924 No. 3

A BIPOLAR THEORY OF THE NATURE OF CANCER

PRESIDENTIAL ADDRESS, AMERICAN SURGICAL ASSOCIATION, APRIL 17, 1924

BY GEORGE W. CRILE, M.D.

OF CLEVELAND, OHIO

THE history of medicine has shown that the field of cancer has been a hospitable cemetery for the hopes of the sponsors of many theories and the problem presented by man's grimmest enemy is still a mystery. It is not necessary to enumerate before this group any statistics to remind us of our obligation to prosecute the study of cancer by every method of investigation at our command. For these reasons, therefore, I have decided to offer a discussion of a theory as to the nature of cancer which is suggested by a new line of investigation. It is not expected that this theory will escape the common lot of cancer theories, but whatever happens to the theory certain facts will probably survive.

Cancer originates and lives only in the living—never in the non-living. It follows that our problem is concerned with the struggle for survival between the cancer cell and the normal cell; and the logical point of attack therefore is the nature and structure of the normal cell as compared with the nature and structure of the cancer cell. It is proposed, on this occasion, to search the normal and cancer cells for such physical differences as may explain the superior ability of the cancer cell to multiply at the expense of other tissues in which it grows.

The best known example of growth energy is that initiated by fertilization in reproduction. The outstanding facts regarding fertilization which may throw light on the cancer problem are the following:

1. The spermatozoon has the properties of the nucleus of the ovum with which it unites.

2. The spermatozoon may be said to reinforce the nucleus and as a consequence,

3. The quiescent negative ovum flares up in active metabolism and growth and in consequence shows a striking change in its internal structure and assumes electrical properties; *i.e.*, electricity is a constant phenomenon from the moment of fertilization, so long as the life of the new individual lasts.

This comparison of the processes of the multiplication of cancer cells with

that of fertilized cells is no new conception, the similarity of the nuclear changes having even led to the supposition by some that malignant processes actually were the result of some form of fertilization. Moreover the cyclic variations in the growth of tumors correspond to the cyclic changes in nuclear and mitotic activities which have been observed in protozoons.

The whole histologic picture of malignancy indicates that it is primarily nuclear in origin as is suggested especially by the large nucleus plasma ratio which is maintained either by the size of a single nucleus or by multiple nuclei; by nuclear hyperchromatism in the active stages; and by the shrinkage of the nuclei in the degenerating or necrosed areas.

On the basis that the processes of cell division in cancer are analogous to the processes of cell division in fertilized cells, we shall report certain biophysical researches and point out certain pertinent facts tending to show that cancer falls within the domain of the electro-chemical or bipolar theory which we believe applies to normal living processes.

Certain analogies between cancer and the pyogenic infections may aid in this interpretation. Cancer cells multiply, bacteria multiply, each finds restraint in certain tissue. Neither cancer nor the pyogenic infections commonly attack tissues of high oxidative capacity; thus neither cancer nor pyogenic infections primarily attack the heart muscle, the voluntary muscles, the cortex of the brain, the normal thyroid gland, the liver, the parenchyma of the kidney, the spleen, etc. No enzyme, no specific chemical property has been found to account for this fact. These are tissues of high chemical activities; these organs are homogeneous in structure and their unit cells are closely approximated and bathed in fluid; in other words, these organs are concentrated cell suspensions. Neither infection nor cancer attack successfully the anatomically and physiologically intact surface layers of cells like the skin and mucous membranes, the latter in turn being electrically charged cell suspension systems; they attack rather the less cellular structures which normally are protected by cellular layers.

Our first generalization then is that cancer originates not in the *midst* of a cell suspension such as the cellular organs, but at the boundary points between highly cellular and less cellular structures. These less cellular structures—subcutaneous, submucous—are successfully attacked by cancer or infection only when the cellular defense is broken down; in the case of a pyogenic invasion a single break in the line of defense may be sufficient for entrance; cancer depends rather upon the gradual lessening of the defense which results from the frequent breaking down and building up. Once the rapid infection or the slower cancer has passed this first line of defense, each follows the path of least resistance—namely, the lymphatic channels and the connective tissue, rather than attacking the solid cellular organs.

Another analogy between cancer and infection is found in the fact that

each obeys laws of cell division and growth which apparently are the same as those which govern the cells of the host.

Both cancer and infection are repulsed by vigorous metabolic activity within the defending structures; thus, as we have already noted, the heart muscle, the voluntary muscles, the normal thyroid, are relatively immune. To this fact, we may add the significant fact that bacteria do not attack the most active part of the cell itself; that is, the nucleus of the cell is immune to pyogenic invasion. To this statement it should be added that the cell nucleus and bacteria show a similar stain reaction. Finally, unlike the normal cells of animals, cancer cells and bacteria have no specific function; they possess only growth energy.

A consideration of these facts suggests the following biophysical interpretation based upon the argument which was presented in the Murphy oration as published in the April, 1924, issue of *Surgery, Gynecology and Obstetrics*. The conclusions drawn from that argument are (1) that the difference between the living and the non-living depends upon the accumulation of free energy on the dielectric lipoid films which surround the nucleus and the cytoplasm and the numerous spherules within the cells; (2) that the charges on these films are derived from oxidation; (3) that oxidation within the cells is governed by the difference in energy potential between the nucleus and the cytoplasm; and (4) that therefore both the growth and the special function of cells are dependent on their structure and their energy potential. Thus the area of oxidating surface in the nucleus of a cell as compared with the area of oxidating surface in the cytoplasm is another way of expressing the nucleus plasma relationship and signifies that the larger the nucleus in comparison with the cytoplasm the greater the energy potential of the cell. Thus, if two cells have an identical organization, an identical energy potential, then, with respect to each other in the competition for nutrition their chances are even, but if in one of two adjacent cells the size and organization of the nucleus is such as to give it a greater capacity for oxidation, hence a greater demand for nutrition, then the cell of comparatively low oxidative capacity will suffer in the competition and will break down in starvation.

As we have stated above, in cancer cells the nucleus plasma relation resembles that of fertilized cells. Before fertilization the ovum in itself is so lacking in organization and hence in oxidative capacity that there is apparently little or no difference in potential between its nucleus and its cytoplasm—it carries no electric charge, it is inactive, negative. But when the nucleus of the ovum is reinforced by the nucleus-like spermatozoon there is at once established a difference in energy potential within the cell, oxidation becomes rapid, nutrition is demanded, the size of nucleus increases, mitosis is inaugurated, cell division occurs.

As we have stated, our interpretation of cancer assumes that the difference between the cancer cell and the neighboring cells of lower potential is analogous to the difference between the unfertilized and the fertilized ovum. The

analogy ends, however, once the mechanism of cell division has been established, for cancer cells have little or no differentiation.

If the foregoing biophysical interpretation be correct, then cancer tissue must meet the following biophysical requirements: (1) the cancer cells must have a high capacity for the storage of electric charges and (2) the conductivity of cancer tissue must show specific variations from the conductivity of normal tissues. That is, if our assumption is correct, then the lipoid films of cancer cells of normal cells and of fertilized cells would take electric charges in a direct ratio to the combined surface area of their lipoid films. For instance, though in its external appearance a fertilized fish egg is apparently the same as an unfertilized egg, one would expect the former to show a higher capacity than the latter; one would expect that the capacity of cancer cells would be higher than that of normal cells. One would expect that radiation would lower the capacity of cells. One would expect to find a higher capacity in such cellular tissues as the brain, liver, muscles, adrenals, thyroid, spleen, pancreas, than in such indifferent tissues as connective tissue and fat.

Our first researches along biophysical lines were a series of conductivity measurements of normal and of pathological tissues made in collaboration with Helen Hosmer, B.S., and Amy Rowland, M.A. The clinical tissues measured included malignant and benign tumors of the breast and of the uterus, ulcer and carcinoma of the stomach, carcinoma of the rectum, malignant and benign tumors of the mouth, jaws, and neck, X-ray burns and various types of goitres—hyperplasia, fetal adenoma, multiple adenoma, toxic adenoma, exophthalmic goitre, simple colloid goitre, thyroiditis. The following were the significant findings:

1. In all instances in which comparative measurements were made the conductivity of the malignant growth was higher than that of a normal portion of the same organ.

2. The outer growing parts of cancers showed a high conductivity in contrast with the conductivity of the central non-growing parts.

3. Among the goitres studied the highest conductivities were found in the degenerating adenomata and the malignant thyroids; the conductivities of the hyperplastic thyroids were lower; and the conductivities of the colloid goitres were the lowest of any of the pathological tissues studied.

These measurements were made with an alternating current of 1000 cycles. This comparatively low frequency of current would probably find the path of lowest resistance, in large part, undoubtedly through the intercellular tissues.

Extending this line of inquiry, the theoretical requirement that cancer tissue must have a high capacity for the storage of electric charges, was given to Hugo Fricke, Ph.D., and Sterne Morse, M.D., of the Biophysical Department of the Cleveland Clinic Foundation, for investigation. The versatile mathematical mind of Doctor Fricke has derived a formula and devised an

apparatus whereby frequencies ranging from 100 to 1,000,000 or more cycles can be applied to the cells under investigation. Up to the present time currents varying from 3000 to 125,000 cycles have been used. The physical estimations of the capacity of normal tissue and of benign and malignant tumors thus far made are as follows:

Eighty tissues from 58 cases have been investigated, including 15 carcinomata of various types, 3 sarcomata, 3 benign tumors and 16 goitres of various types. The capacity of normal tissues have ranged from 0.47 for fatty tissue, and 1 to 3 for connective tissue to 10 for the normal uterus. All of the carcinomata have had a relatively high capacity ranging in the arbitrary units used from 11 to 32 in the actively growing portions of the growths. The degenerated portions of the growths have had a lower capacity and the capacity of radiated tissues has been much lower, the tissue in one radiated case showing as low a capacity as three. Thus far in every case studied the tissue in which the cancer had developed had a lower capacity than the cancer itself. This difference has been particularly marked in carcinomata of the breast in which the capacity of the adjacent glandular connective or fatty tissue has often been less than one-tenth that of the malignant tissue. Among the goitres, colloid goitres have shown the highest capacity of any tissues studied, as much as 76 in one case, the average being in the neighborhood of 40. This finding is of prime significance in view of the fact that cancer of the thyroid never develops in a colloid goitre. Adenomas and hyperplastic thyroids have, as a rule, had a low capacity for glandular tissue which in general seemed to show a somewhat higher capacity than other tissue. Connective tissue has usually a very low value, between one and three, and the capacity of fatty tissue may be as low as 0.47, while an active inflammatory process may show a capacity of 20.

The findings in these researches suggested at once that the whole story of cancer may ultimately be derived from conductivity and capacity measurements. These findings moreover are in accord with the histologic picture presented by the microscope. The microscope indicates the general structure, which in turn *indicates* the capacity of the cell for work, multiplication, function, etc. A further striking parallel between the cytologic picture and biophysical findings, is found in the fact that Ewing and Wood have shown that cells which have been subjected to lethal X-ray or radium radiation, show loss of differential stainability and in our laboratory Morse has shown that heavily radiated tissue almost wholly loses its capacity.

Armed with these physical facts, let us see to what extent some of the well-known facts regarding cancer may be harmonized. First of all, on the basis of electric potential, implying as it does oxidative capacity, if two cells are side by side competing for food, the one having the higher potential, such as the fertilized cell or the cancer cell starves out, and if the higher potential—higher oxidative capacity—persists long enough, destroys the ordinary tissue. Among cells with equal capacity such as those within the cancer itself or the

daughter cells of the fertilized ovum, division occurs evenly, no one starves another. This fact explains why cancer does not arise either primarily or secondarily in that fiery furnace, the heart muscle, or in other muscles, or in the cortex of the brain or in the thyroid gland, etc. It also indicates why, when from some cause, the capacity of an epithelial cell resting on subcutaneous or submucous cells of low capacity has been increased until it is equal to the capacity resulting from fertilization, that cell will easily rob the neighboring inactive tissues of their nutrition and will supplant them, just as the vigorous growing weed overgrows and supplants the highly differentiated less vigorous domestic crops.

A consideration of the conditions under which cancer develops in the thyroid gland is illuminating. First, cancer almost never develops in the normal thyroid or in colloid goitres, but over 90 per cent. of cancers of the thyroid arise in fetal adenomata. Now, as has been stated above, the capacity measurements made by Morse show that both colloid goitre and the normal gland have a higher capacity than cancer of the thyroid while the capacity of fetal adenoma is lower than that of cancer. Now on the basis of our premise one would have predicted that that would be the case, even though he knew nothing about the actual incidence of cancer in the thyroid gland.

Again, let us consider one of the most common sites of cancer origin, the breast. Here is an organ whose structure contains epithelial cells, the capacity of which is low. It follows that when some circumstances bring cells with a relatively high potential into contact with these low capacity epithelial cells, the former multiply at the expense of the other breast tissue. The capacity of cancer of the breast is from two to ten times higher than the capacity of normal breast tissue. The capacity of the tissue near the cancer mass is somewhat higher than that of normal tissue. In general, benign tumors have a higher capacity than that of the organ in which they grow, *e.g.*, the capacity of a fibroid is higher than that of the normal uterus.

There is a general analogy to this conception of the law governing the incidence of cancer in the various tissues, in the tables of Voit, which show that in starvation the weight of the brain and of the heart muscle does not change, the reason being that these tissues, the metabolism of which is at a higher rate than that of other tissues, consume the nutrition at the expense of the others. For the same reason a fœtus thrives up to the point of starvation of the mother.

This conception explains the higher incidence of cancer in old age when the generally falling metabolism would diminish the already low defense of the tissues of low capacity and lead to an inequality in an already wavering balance between the capacities of neighboring cells. Moreover the older and the feebler the subject, the slower the growth of cancer and the better the prognosis; and *per contra* the younger and more vigorous the subject, the shorter the course, the more fatal the cancer. But youth has fewer cancers

than old age. Our theory interprets this antithesis as follows: In the general activity of all tissues in youth it would be unusual to find the potential of any one cell raised above that of its equally vigorous neighbors, but once so phenomenal a cell has been produced, its growth energy would be enormous, rapid and fatal. In old age, on the other hand, with its universal decline in activity, although a cell may more readily become endowed with the equivalent of fertilization so that its potential and its capacity may become higher than those of its feeble neighbors, yet it would have a very moderate growth energy. In fact, cancer in the aged and feeble inevitably would appear just above the low level of low vitality, in youth just above the high level of general vitality. In youth the cancer must be virile; in age it must be feebler. Thus, in experimental studies cancers are not transplanted to the muscles, nor to the liver, nor to the heart, nor to the brain, but to the more negative tissues; it is the subcutaneous quiescent breast tissue that is generally selected as the site for the graft.

If one could plant a self-limited bacterium in the nucleus of a cell, its added oxidation might augment the nucleus in a manner analogous to the augmentation of the nucleus of the ovum by the spermatozoon so that in consequence cell division would be forced. Or if one could draw the nucleus out of one cell and insert it into a sister cell, thus reinforcing its nucleus. the energy potential of the latter cell would be increased, its nutrition intake increased and cell division would follow, *i.e.*, a cancer would be produced.

The interpretation of another fact is made possible by the bipolar theory, namely, the like action of X-ray and radium on cancer and on fertilization. The effect of radiation is to interfere with the mechanism in the cell for the creation and storage of electric charges, an interference which as effectively prevents growth and function as does the permanent injury to the plates of a battery.

Certain everyday facts about treatment are also open to a biophysical interpretation. Thus if a cancer is entirely removed, early, no return is seen, whereas if these electro-chemical mechanisms are stimulated by injury, by partial operation, by inflammation, by chemical agents, by X-ray, by radium, by heat, by electricity, the resultant struggle and survival kill off the weaker cells, leaving the stronger. When a massive treatment is given any cells which survive will be the fittest, hence the return growth will be at the pace of the strongest, the fittest cancer cells, not of the less strong cells that did not survive. The combination of diminishing vigor, on the one hand, and a stepping up on the other, theoretically would bring about the unbalance required for cancer.

Pyogenic Infection.—We have already mentioned certain analogies between cancer and pyogenic infections. Certain further biologic principles governing infection which appear to be the same as those governing cancer may be cited. The resemblance between cancer and infection has been noted by many observers. Pyogenic bacteria may be regarded as free nuclei, like

the fragmented nuclei seen in many unicellular organisms. If we regard the law of universal bipolarism as a necessary condition by means of which a difference in potential is created and oxidation controlled with resultant electric charges and maintenance of potential, we may interpret bacteria as free nuclei depending for their common negative pole on the common colloids such as mud, soil, seawater, etc., or the colloids in the tissues and fluids of animals. Bacteria then will multiply as free nuclei.

A cancer cell is a bipolar mechanism within which the nucleus is the positive, the cytoplasm the negative pole; bacteria are positive poles with lymph and tissue juices as a common negative pole. According to this conception the cancer cell and the bacterium are in a common class of high potential invaders. Now the bacterium like the cancer cell must depend on its ability to compete with the cells of the organism for nutrition. It is probably a consequence of this fact that bacteria, like cancer, cannot primarily compete with the cells of the organs which have a high metabolism. Bacteria like cancer attack best the negative tissues, the subcutaneous tendons, the fascia, the bone, surfaces that have been irritated. Bacteria stain like nuclei; bacteria almost never attack nuclei of cells, almost never muscles, most seldom of all the heart muscle. Bacteria tend to spread by the adynamic lymphatic system rather than by the dynamic blood stream. However, as in the cancer, if bacteria are potent enough, *i.e.*, have the required potential to multiply in the blood stream those bacteria are more apt to kill and to kill early. We find then that both bacteria and cancer cells multiply at the expense of their host; both may form tumors; both cause reactions; both interfere with function; both are selective as to the attacked organs, as to invasion. Though they have much in common, they are nevertheless entirely different.

As to the problems suggested by this discussion it would seem that in the capacity estimations we may have one more criterion for the diagnosis of cancer. Should this hope be realized, the estimation of capacity will best be made on fresh unstained tissue almost instantly after its removal or when conditions permit, *in situ*. Even if this should not become a specific method of operating room diagnosis, it will quite surely, even in its present status, supplement the microscope. We may perhaps find in this new biophysical method not only a means of diagnosis, but one of prognosis as well—a low ratio of the capacity of the growth to that of the adjacent tissues would theoretically mean low malignancy and vice versa. There is one more and a unique possibility, namely, that after the effects of radiation on capacity have been studied further it may be that the capacity of a tumor may at last furnish the key to the amount of radiation required as a lethal dose; or indeed it may determine whether any dose that the normal tissue of the organism could endure would cure, so that futile efforts could be avoided. There are still other interesting lines of investigation but a discussion of these is reserved for a further report by Doctor Fricke and Doctor Morse.

In conclusion one of the greatest obligations science owes to humanity is the control of cancer, and it is hoped that the suggested theory, on the one hand, and on the other hand the new facts which have been and are being demonstrated by the more exact sciences of mathematics and physics, may contribute a new method of attack. The theory has at least this advantage, that it has been formulated and developed on the basis of exact mathematical formulæ and physical laws and in consequence can the more readily be disproved if not true, and if true can be the more easily defended.

THE FULL THICKNESS SKIN GRAFT*

By Vilray P. Blair, M.D.
of St. Louis, Mo.
FROM THE SURGICAL DEPARTMENT OF THE WASHINGTON UNIVERSITY MEDICAL SCHOOL

There seems to be little question that the Ancient Hindus made free transplants of the full thickness of skin and included some of the underlying tissue, but their percentage of successes may not have been very high. The

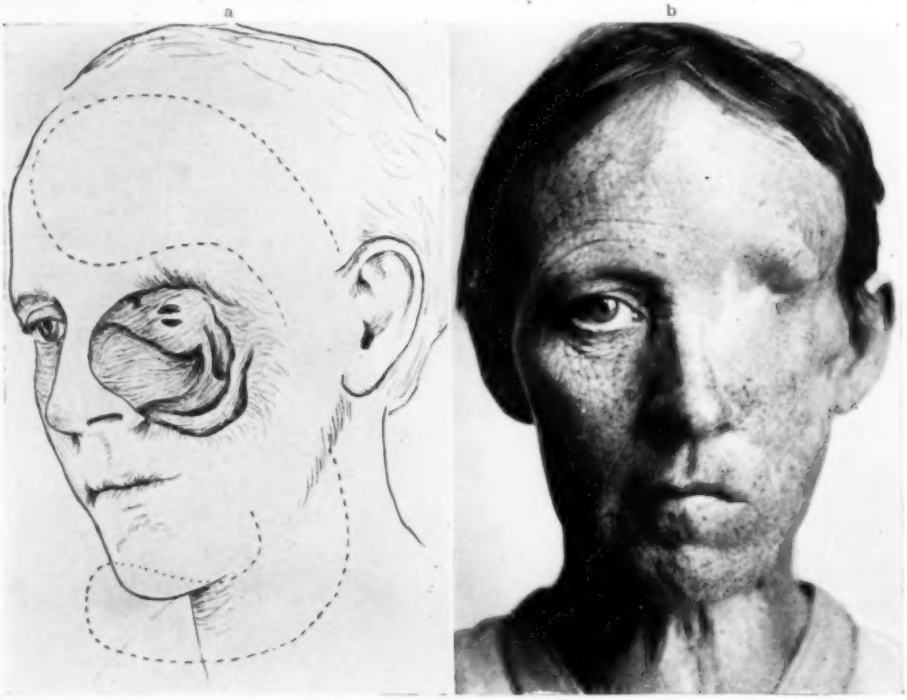


Fig. 1.—Shows a full thickness graft on the forehead used to replace a flap that covered the cheek or orbit defect. On the third day after operation, because the graft was found to be dusky, the epidermis was incised to relieve the congestion and this produced a very free flow of bright red blood.

accepted technics and standards of to-day are not based on the Hindu method, but are rather an evolution, an early stage of which was recorded by J. Mason Warren in 1843. Its later developments have been chronicled by various surgeons down to and including J. Staige Davis, who has made valuable contributions to the technic and has given us one of the most comprehensive reviews and bibliographs on this subject. Another and more recent review is by Neuhof. From these latter we learn that the contributions of both Wolfe and Krause appeared chronologically rather late in this evolution.

In spite of all that has preceded, it still remains a surgical resource of which the profession at large is not making full use. The following account

* Presented before the American Surgical Association, April 19, 1924.

of our experience with this method of covering external surface defects is presented not as something new, but on the possibility that it may help to stimulate more interest in the procedure which in turn may hasten the elimination of certain malign influences that still cause our own results to fall far short of 100 per cent. perfect.

Excluding army and Veterans' Hospital cases, it is based upon 106 auto grafts done in the past four years by Dr. Ellis Fischel, Dr. Earl C. Padgett, and by the writer on patients in whom the latter was directly interested. A definite plan of technic was followed that required about a year to develop and has not been materially changed since.

These operations were performed at the Barnes Hospital, the St. Louis Children's Hospital, and the St. Louis Mullanphy Hospital. This tabu-

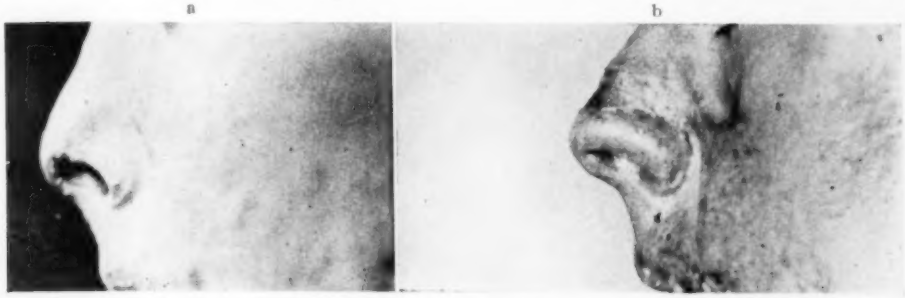


FIG. 2.—Shows boy with burnt face. The end of the nose is abbreviated and there is an ectropion of the nostrils which caused the nostril hair to grow on the outer surface of the ala. To correct this a transverse incision was made across the dorsum from cheek to cheek and the scarred superficial tissue was undermined and rolled downward until the ala and tip were restored. The resulting diamond-shaped defect was filled by a full thickness graft that was sutured in under tension. This was the first case of this series and the ease with which the result was obtained led to the erroneous conclusion that suturing in the graft at normal tension was all that was needed to get 90 per cent. satisfactory takes.

lation does not include quite all of our cases, for in many instances the skin graft was but one incident in an operation and has not always been separately indexed.

All negative statements that may follow are to be taken as referring only to the cases in this series and not to imply that positive results might not be obtained by some other technic or under some other circumstances.

Dissatisfaction with the ultimate results of the "Thiersch" graft when used on skin surfaces was the driving motive. The work as started was based on two premises: First, that if the transplanted skin were held at its normal tension or at slightly plus tension the cut ends of the cutaneous vessels would be held open and would more quickly take up a blood supply; the second, that as each particular part takes its blood supply from the immediately subjacent tissue, the only logical limit to the size of a graft would be the amount of operating and hemorrhage the patient could stand. Subsequent experience justified both of these conclusions. A very free arterial blood supply has been demonstrated by scarifying a graft 48 hours after implantation (Figs. 1 and 2), while numerous subsequent observations have proven

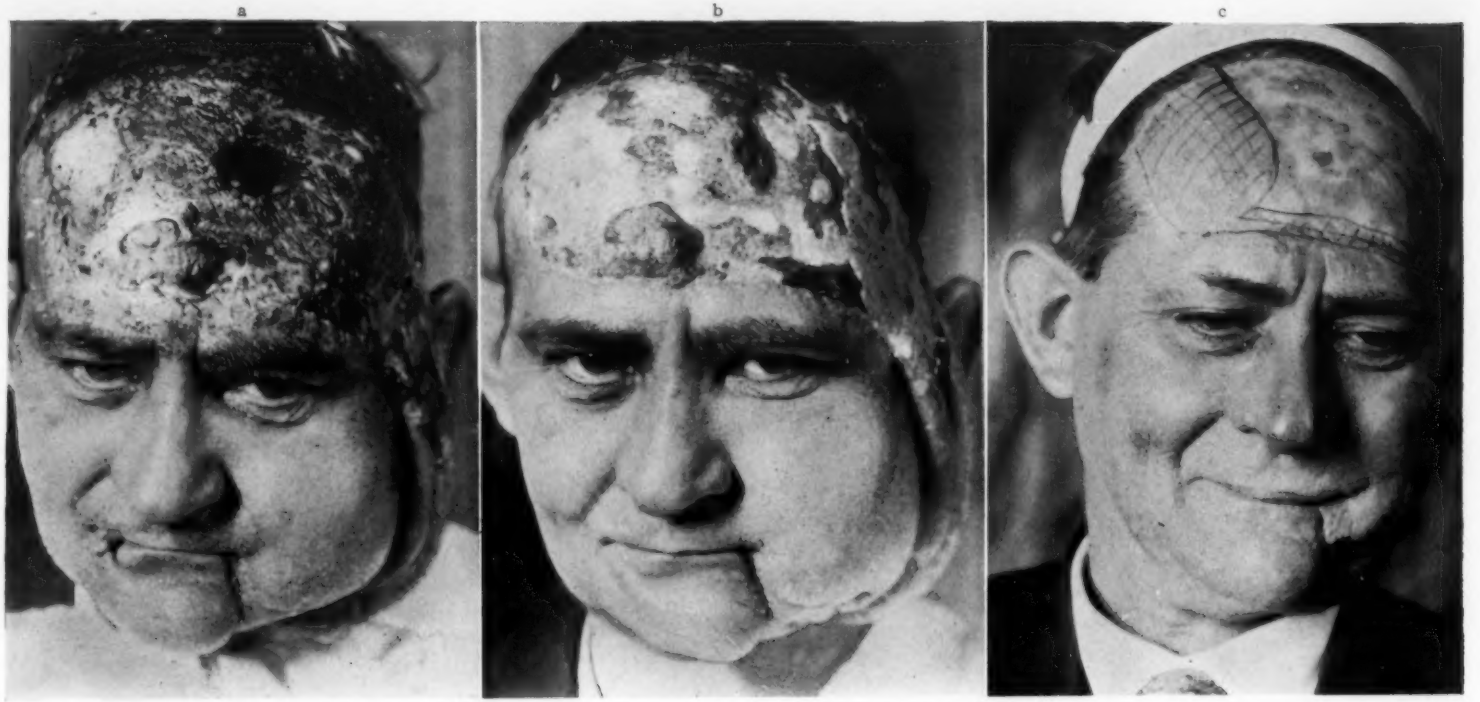


FIG. 3.—Shows defect filled with a 3½ x 8 inch full thickness graft from the abdomen in a man fifty-six years old. This graft was cut by a pattern that was the size of the defect, but instead of the graft contracting, as is usually the case, it stretched so that when it was sutured into the defect it was quite loose. (Operated March 21, 1923.) In (a) taken thirteen days after placing the graft the imperfect "take" is already apparent. In (b) taken twenty-two days after operation the dead skin has been thrown off and the granulating areas are evident. (c) Taken one year later shows the surface healed partly by scar. The cross lines show the areas into which sensation has been restored, but in the scarred region it has not returned.

that a graft not on tension is uncertain about acquiring a blood supply. (Fig. 3.)

Very soon after these two hypotheses were put into practice it became evident that there were additional factors of almost equal importance that still remained to be catalogued. Certain of these have since been identified but not without some heart-breaking experiences and the indulgence in considerable worry; others have so far baffled our efforts. The first of these stumbling blocks was a fact long ago recognized in dealing with large thin

FIG. 4.—Shows a full thickness skin graft on the forehead that replaced a "delayed flap" used to reconstruct the nose. The central part of this flap was thicker than the outer part, which left a deeper depression in the centre of the resulting defect. A simple gauze pad was bandaged over the graft and this did not compensate for the lack of counter pressure in the central part. It will be seen that the central part of the graft where the pressure was less has died as the result of venous stasis.

flaps; that it is one thing to have an arterial blood supply and quite another to have an adequate venous return. In the first several cases the grafts were applied to the bridge of the nose or to the forehead. (Fig. 2.) In the former the tension of the sutures drawing the graft over a curved firm surface, and in the latter the pressure of the bandage that held the dressing; both helped to limit the amount of blood that could stagnate in the skin while the new venous return was being established. It was not until the attempt was made to place a large graft on the cheek that we were forced to conclude that in the previous cases good luck had outrun calculation. In the particular case in point the retaining dressings were removed at the end of two days for fear mouth secretions might seep under them and the newly adherent graft was left exposed. Within a few hours the pale pink skin became deeply blue and repeated scarifications, carried on night and day, and citrate of soda packs failed to save us from the painful necessity of explaining to the patient the loss of seven-tenths of a 3 x 4 inch graft. Three months later, after shaving off the granulations, another graft was applied, but this time it was

FIG. 5 (a, b, c).—Show three stages of a graft, 70 per cent. of which was lost from excessive pressure. This was one of the very earliest cases in which the sponge pressure dressing was used and it was put on so tight that the face was dusky from venous congestion. (a) The first picture, taken the day after the original dressing was changed, shows much of the graft dark and inelastic but adherent. In (b), taken two days later, the most superficial layer of epithelium has peeled off, showing a patch of pink, live skin. In (c), taken twenty-two days after operation, the dead part of the graft has been thrown off, leaving a patch of live skin and a granulating surface. The submaxillary and submental graft, which was not subjected to so great direct or counter pressure, survived almost intact.

protected by dressings held in place with a pressure bandage. That part of the graft survived which lay over a wax form in the hollow of the cheek which furnished counter-pressure. (Fig. 4.) Based on this experience a marine sponge pressure dressing was evolved which, if carefully applied and made of sponges of proper quality, will maintain an even pressure over an irregular surface or one without underlying bony counter-support. Further use of this pressure dressing demonstrated an unforeseen virtue and an inherent danger. It permits of the application of the graft over a freshly made raw surface, such as results from the removal of a scar, without tying any but large vessels, but if the pressure is too great, especially over a bony prominence such as the outer part of the supra-orbital ridge or dorsal surface of the middle metacarpal bone, it can kill the compressed area by ischæmia. (Fig. 5.) Maintenance of the proper pressure for four or five days will prevent the graft from dying from engorgement, but its early discontinuance favors the formation of blebs, which latter may lead to

another catastrophe. (Fig. 6.) The blebs are apt to become infected, sometimes at least, from organism contained in the skin. If this infection is not controlled, the resulting ulceration may not stop until it has eaten through the full thickness of the skin. This ulceration seriously marred a number of our earlier final results, and in many of our later cases we were only somewhat less bothered by it. Dr. Martin Engman, while seeing one of these cases in consultation, advised painting the infected base of the bleb with a 1 per cent. silver nitrate solution. We have since continued its use and I think it greatly helps to control this ulceration. Also to help control this infection and to prevent the dressing from sticking, a layer of gauze impregnated with 3 per cent. xeroform ointment is laid on the graft under the pressure dressings. The use of this ointment is continued as long as dressings are deemed necessary, and it is certain that our later results are much less marred by scars resulting from patchy destruction of the epidermis than are our earliest cases; however, this source of error has not yet been entirely eliminated. Very recently, to control this superficial infection, we have in several cases used for the later dressings a 2 per cent. boric acid pack under impervious dressing apparently with somewhat more promising results. (Fig. 20.)

FIG. 6.—Shows the blebs that form after the too early removal of the pressure dressing. These blebs may form under the pressure dressing, but are not apt to be so extensive nor so troublesome.

Blood clots of any size will cause the death of the overlying skin. It is impracticable to tie all or sometimes any considerable number of the bleeders after the removal of a burn scar, but properly graduated sponge pressure following appropriate puncturing of the graft with a fine leather punch, as advocated by Davis, or with a knife, and carefully squeezing out all clots before applying the pressure dressing will do much to eliminate this source of disaster. A "Thiersch" graft can be wrapped around a wax form and buried in the tissues with every expectation of a perfect "take," but our observation leads to the belief that the full thickness graft requires some ventilation during the first few days after it has been transplanted. This conclusion is based on the following experiences: Several times a rubber bath sponge was used in place of a marine sponge; in one case the outside dressings were all covered thickly with vaseline to prevent the possibility of vomit

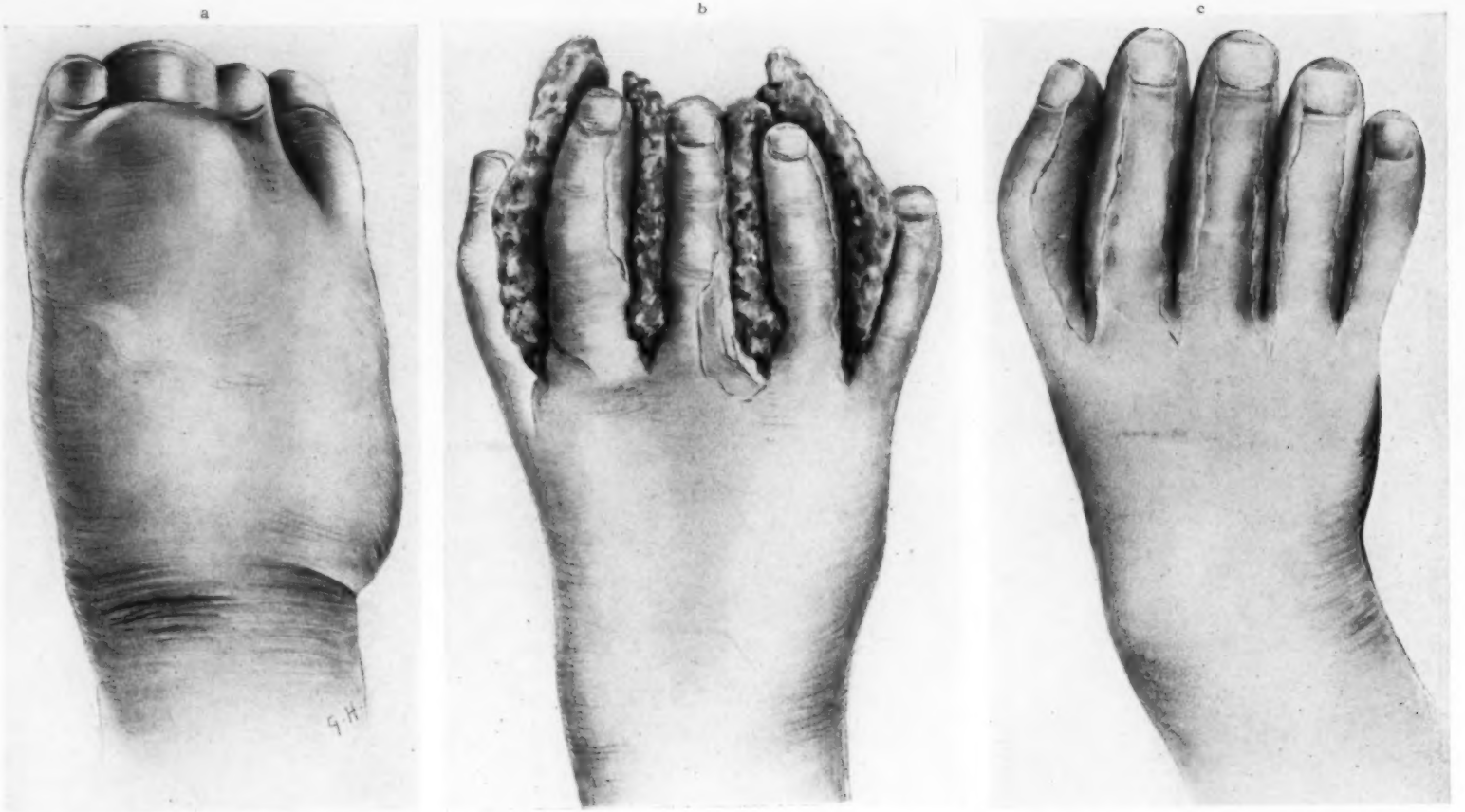


FIG. 7.—Shows a complete syndactylism in a five-year-old boy in which the two outer clefts were lined with full thickness grafts and the two inner with "Thiersch" grafts. All were sutured in place, the whole operation requiring one hour and ten minutes. The clefts were cut as deep as could be without dividing the transverse metacarpal ligament, but the grafts contracted so that it was advisable to again deepen the clefts and regraft approximately 8 months later. At this time the full thickness grafts had contracted considerably less than had the "Thiersch."

soaking into the marine sponge; in another case the full thickness graft was sutured around a wax form under normal tension and buried in the floor of the mouth through an external incision, and in still another a very soft old sponge was put on with such pressure that it made an almost impervious casing. In the above cases much or all of the grafts macerated and a considerable part of each graft was lost. The observations of Allen Kanavel and J. Staige Davis do not seem to support the preceding. The former fixes small

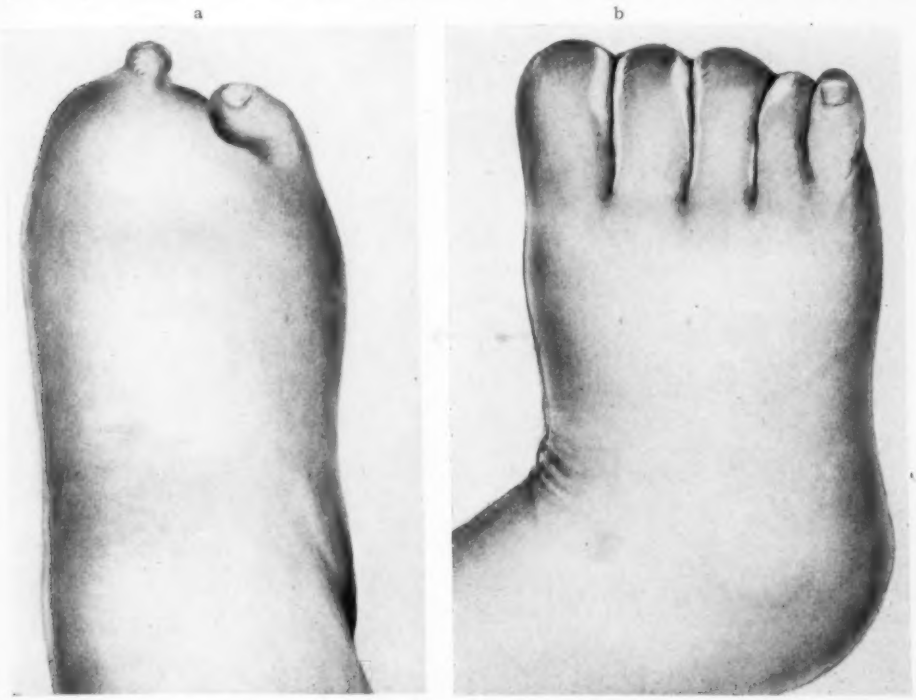


FIG. 8.—Case of complete syndactylism of the foot. Here part of the clefts were lined with "Thiersch" grafts and part with full thickness. Note how, after freeing the toes, the foot flattened out to form a usable member. In this instance the subsequent contraction, though quite as great as in the preceding, did not interfere with function.

grafts under wax forms and the latter buries full thickness grafts under delayed pedicle flaps sometime before transplanting the flaps. There may be still other causes that produce local areas of "death" of the graft and upon this subject we are still seeking light.

The shrinkage of the graft bears no proportion to the amount of contraction that occurs in a "Thiersch" graft. If the epithelium is preserved, the contraction will be not more than would occur in the healing of a pedicle flap of the same size. If there is more than a very superficial loss of the epithelium, the area from which this loss occurs may contract one-half or more. (Fig. 19.) In some localities, as the forehead, this normal contraction need not be considered, in others compensation must be provided beforehand or made subsequently. This can be done in some areas by doubling back the

skin bordering the defect at the time of operation (Figs. 10 and 11), in other instances an additional graft or a flap has been inserted to release the tissues displaced by the contraction. (Figs. 17–19.) On the hand or axilla, splints used for three weeks will help control contraction (Fig. 13) and the lips or eyelids can be supported either by uniting the corresponding fellows, by suturing newly made raw surfaces, or by suspension sutures (Fig. 19).

The final color of the graft is a thing that we cannot foretell, except that in a general way the darker the complexion the darker is apt to be the tan that will come in the graft. Normally, the abdominal skin has a yellow tinge, but this does not account for the tanning that occurs to a greater or less extent in the majority of full thickness grafts. On "white" negroes this tanning may be very dark. Usually the tan is evenly distributed but sometimes it is blotchy (Fig. 16 c-d); where the graft does not tan it is apt to be pale or white (Fig. 16 a-b). In some cases the transplanted skin will become more pink than it was in its natural position and match the face skin fairly well; tanning appears somewhat late.

FIG. 9.—Shows the partial result that followed the removal of the scar, straightening the finger and covering the raw surface with a full thickness graft in the case of a contracted burn scar. No allowance was made for the subsequent contraction of the scar surrounding the graft and the result can be rated as only a partial success.

In a general way, age has been an influencing factor. As a rule the younger the patient the more certain is the graft to "take" completely and the more natural will be the appearance. However, in a man seventy-nine years old who had a 4½ x 6 inch graft transplanted from the abdomen to the forehead the color and texture were so perfect that it could not be detected by any casual observation. The youngest in this series were two infants grafted for complete syndactylism at the age of one month each. In the adult, and even in young children, these grafts are as resistant to contamination at operation as any healthy tissue, but should infection occur it is apt to be very destructive to the graft itself. At many of these operations it is practically impossible to keep the field clean. In the infant and young child a pus infection may very rapidly destroy large parts of an already adherent graft within the first few days after operation, and this is most apt to occur when

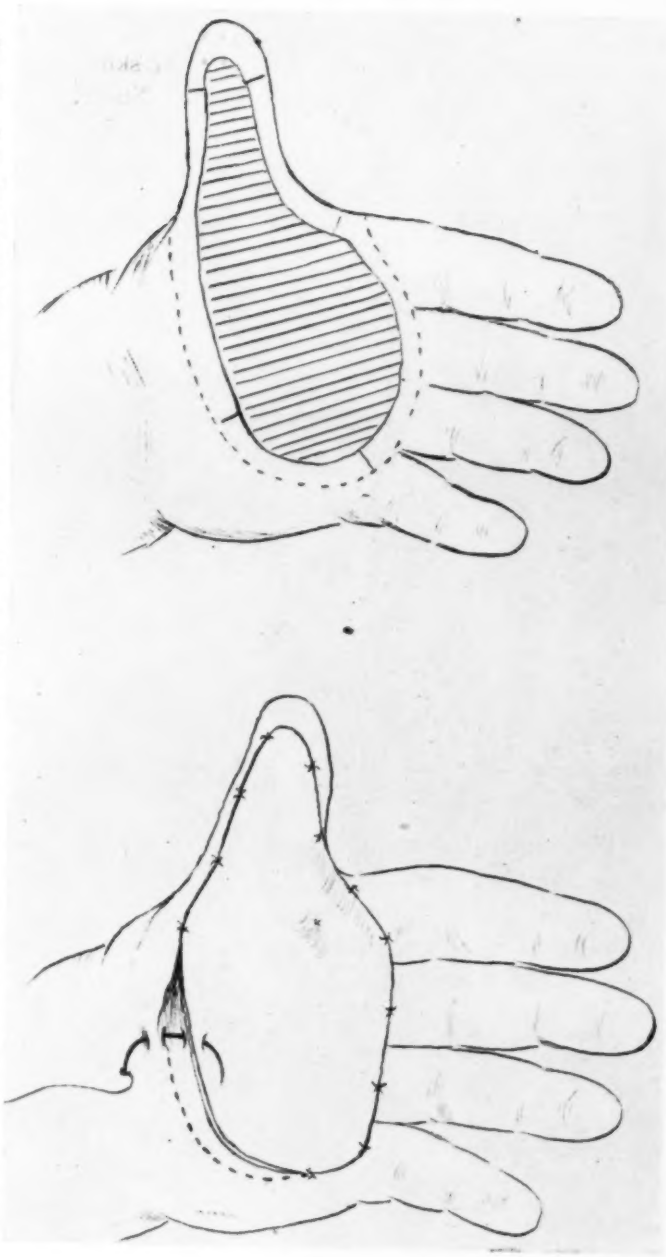


FIG. 10.—Case of complete adhesion of the palmar surface of the thumb to the palm of the hand following a burn. The striped area in the right hand figure shows the extent of the raw area that resulted from the freeing of the thumb; the outer lines indicate the extent to which the surrounding skin was undermined. In suturing on the graft these undermined edges were turned outward, skin surface to skin surface, so that the area of the raw surface was increased by almost twice the area of the undermining. Each suture was passed first through the edge of the graft then through the everted skin edge, and then took a turn through the palmar skin along a line corresponding to the edge of the graft and everted skin. This causes an elevation of the edge of the graft which might slough from the greater pressure to which it is exposed if an even thickness of gauze and sponge is simply bandaged over the whole. Compensation can be made by filling the depressed central part by several layers of xeroform gauze cut to accurately fit within the elevated edges. When the sutures are removed after following this plan, at first the grafted area is surrounded by a ridge, the outer surface of which is formed by the everted skin, the inner surface by the graft. This subsequently flattens out. If any did remain it could be removed after one was sure that the redundant skin was not needed. In cutting the graft for this plan it is made the same size as the raw area when the undermined edges are everted.

the original dressing has not yet been disturbed. It has, however, been our observation that grafts on the infant and young child acquire an immunity to infection earlier than do the grafts on the adult. On the latter the graft seems to be more apt to weather the first week, but is very susceptible to superficial infections occurring under the scarf skin which become manifest in the second or early part of the third week. Such infections can in a few days destroy or very much cripple a previously perfect graft. (Fig. 20.) In one three-year-old child who at the time was not under close obser-

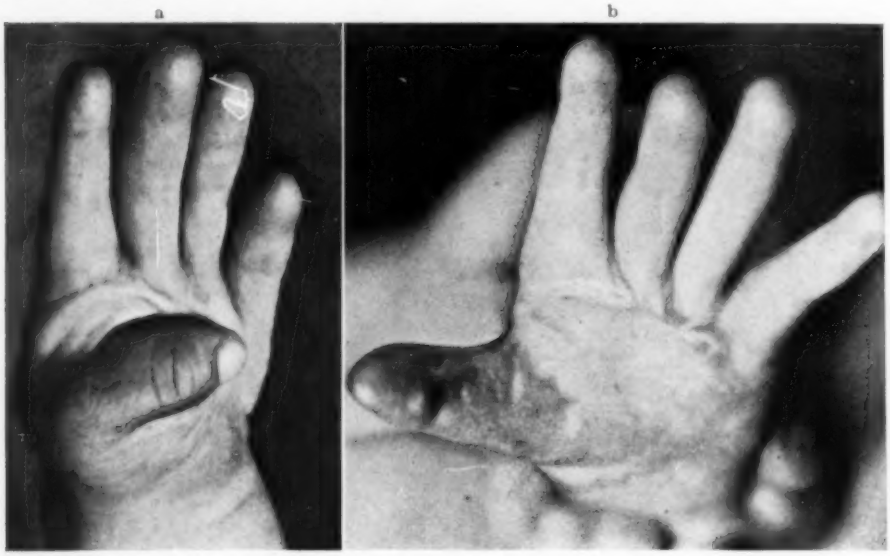


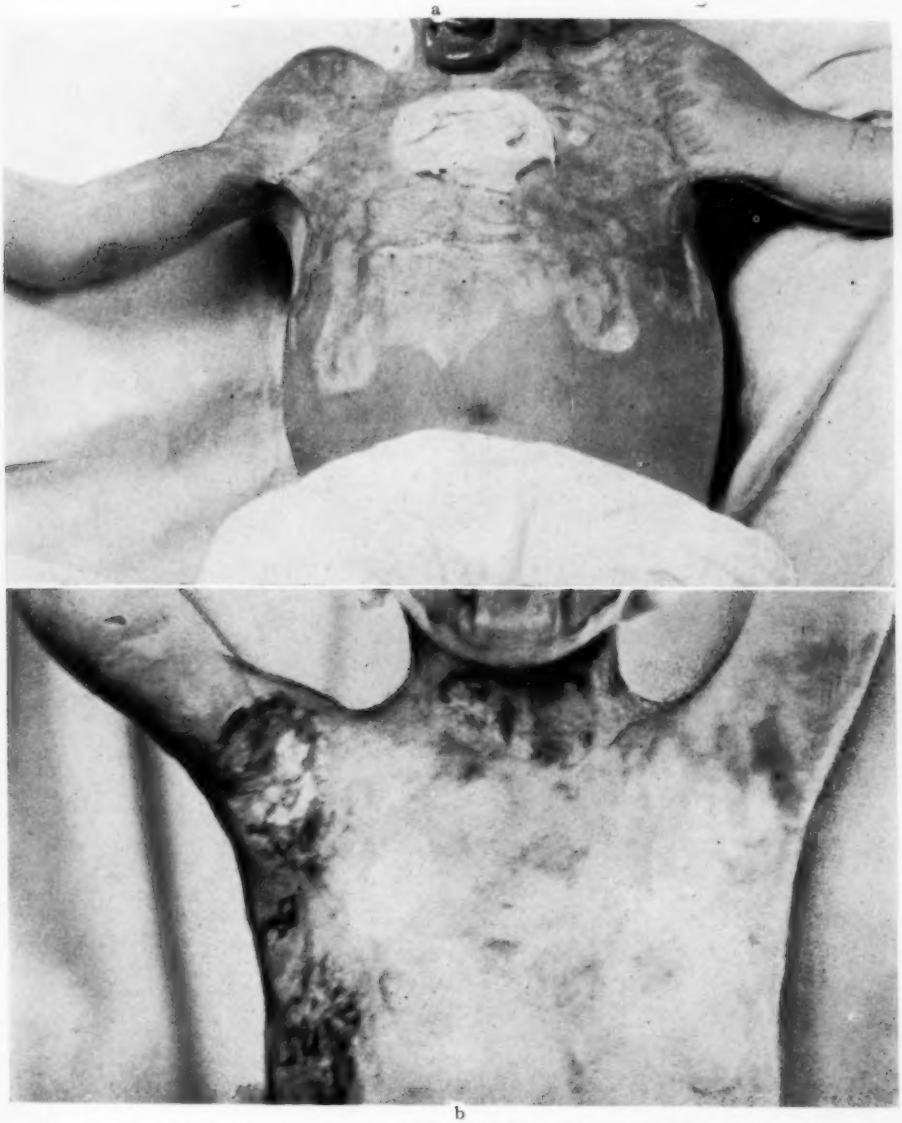
FIG. 11.—Shows case illustrated in Fig. 10. To the left is seen the thumb united to the palm while the photo on the right shows the final condition. Note that the ridges of superabundant skin have disappeared but that the thumb is completely freed.

vation, a destructive ulceration attacked a forehead graft in the third week after operation.

On two cases a graft was transplanted from the mother to the child; in one the blood matched and in the other it did not. In each it was controlled by an auto-graft made at the same time and in each, at the end of the first week the homo-graft appeared to be a perfect "take," even smoother than the auto-graft. In the second and third weeks, however, the homo-grafts macerated and were thrown off while the auto-grafts made good. (Fig. 12.) This is contrary to some reported experiences. Dr. M. T. Burroughs suggested to us that difference in age between mother and child may have been a factor in the failure. John Staige Davis, J. C. Masson (Jour. A. M. A., June 1, 1918), H. K. Shawan (Amer. Jour. Medical Science, April, 1919), and others have reported success with the homo-graft, while R. Minervini (Transactions Medical Congress, Jour. A. M. A., September 6, 1913) used the skin of non-diseased still-born babies and his reported success in this might have some relation to our observation that the younger the child the

more satisfactory the "take." It would be a great blessing in certain burn cases of young children if the skin could be obtained from some other source.

The individual grafts varied from 1¾ to 42 square inches. We have



a

b

FIG. 12.—The photograph above shows a child with both arms bound down by scars in and below the axillæ while the lower one shows them released after incising the scars, abducting the arms, and covering the raw surfaces with full thickness grafts. At the first operation both arms were freed. In the right axilla a full thickness graft from the mother, whose blood matched with the child's, was implanted while on the left a graft from the child was used. The subsequent behavior of these grafts is detailed in the text. At a later operation the right axilla was regrafted from the child.

found that the transplantation of about 40 square inches of skin approaches the practicable limits of the operation, especially when this step is just a part of one operation. The following tables give a résumé of our work:

Indications	Number	Average per cent. of success
Replace delayed flap	34	79.70
Replace immediate flap	2	90
Release or replace burn scar	57	77.87
Replace eyebrow	7	87½
Release ear	3	66⅔
Web fingers	4	76½
Web toes	1	90
Release Dupuytren's	1	90
Scar	1	75
Replace nevus	1	80
Luetic scar	2	67½
Release tongue	1	0
Replace scalp	1	90

Location of graft	Number	Average per cent. of success
Forehead	38	81.32
Cheek	8	58
Eyelid	4	85
Dorsum of nose	2	85
Neck and chin	12	68
Hands—dorsum	10	83½
Hands—palm	9	83⅓
Finger clefts	5	76
Axilla	3	80
Popliteal space	2	70
Floor of mouth	1	0
Toe clefts	1	90
Arm	1	80
Neck	3	85
Eyebrow	7	87½
Ear	2	55
Forehead and scalp	3	86⅔

Tissue on which graft was bedded	Number	Average per cent. of success
Periosteum of forehead	31	78.70
Subcutaneous tissue	13	76.53
Subcutaneous and burn scar	57	77.28
Heavy scar	1	50
Partly on tendon	5	90
Partly on cut bone	2	90
Luetic scar	2	62½
Tissues below floor of mouth	1	0
On a granulating surface	1	80

Number of graft operations 106
Average per cent. of success ..... 77.41 per cent.
Number showing 90 per cent. success.... 58
Average size of grafts..... 8.43 square inches.

These estimates are, of course, somewhat approximate, though all grafts were cut from tinfoil patterns. As a margin of safety in making estimates, no graft was given credit for more than 90 per cent. "take." Where provision for shrinkage or loss had been made a part of the operation, then

a

b

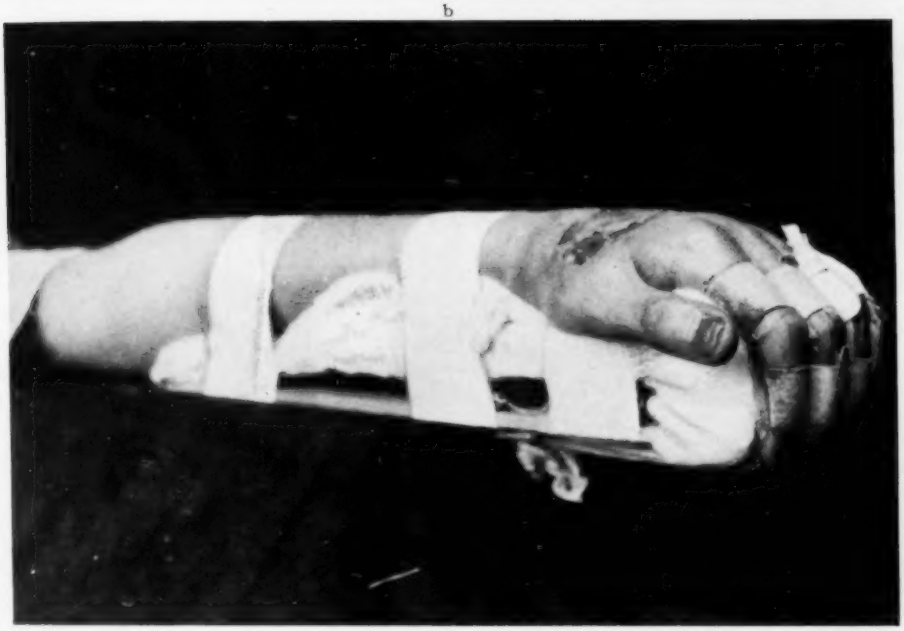


FIG. 13.—One of the great advantages of the full thickness graft over the pedicle flap in the restoration of the burnt hand is that the hand can be conveniently splinted while the free skin graft is healing in place. It is seldom that the skin over the palmar surface of the distal phalanx is involved. After removing the palmar scar, undermining the edges, and suturing in the graft after the plan shown in Fig. 10, a folded piece of 3/8-inch mesh sterile "Hardware cloth" is appropriately padded and the hand is held extended by strips of adhesive plaster that pass over the distal segment of each finger and which are tied through the meshes of the splint. The fingers should at the same time be somewhat separated and the thumb completely abducted. One or two adhesive straps around the forearm complete the fixation after which the usual sponge pressure dressing is bandaged in place. It is well to reinforce this wire splint by bandaging a light board on the dorsal surface after the dressings are applied. We had one graft damaged some days after operation by a fall in which the splint bent. (a) Shows this wire splint applied. The extensor tendons may have become fixed in a burn scar of the dorsum and these can be released when the scar is removed so that the fingers can be flexed. The graft should be patterned so that it will cover the defect with the hand flexed and the hand should be splinted in this position, shown in (b), and this should be continued for some weeks.

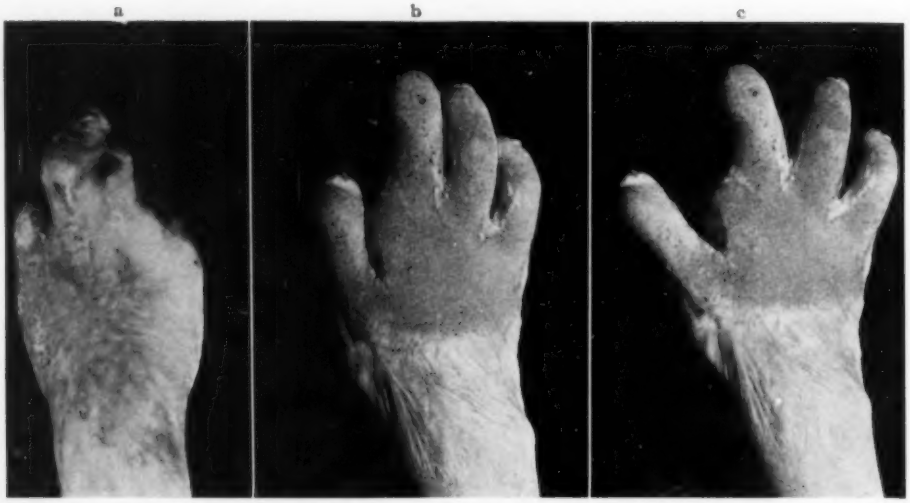


FIG. 14.—The photograph to the left shows a hand burnt on all surfaces with the fingers scarred into one mass resulting from a burn that involved the dorsum and the interdigital spaces. The dorsal skin was restored by removing the scar and planting the hand and fingers in pockets tunneled just under the skin of the lower abdomen. Later the interdigital spaces were epitheliated by full thickness grafts. Figure (b) shows the restoration, figure (c) shows the ability to abduct the fingers.

FIG. 15.—Shows the rough scar resulting from a burn sustained years previously. The whole scar was dissected off and the defect covered with one full thickness graft from the abdomen. Figure (b) shows the graft which "took" throughout. It is of good color and texture.

the final result, not the amount lost, was taken as the basis in making the final estimate of success. Many of these grafts took perfectly, and except for the bordering scar and a slight tanning and shiny appearance the skin

substitution could hardly be detected. In most localities a graft can be so placed as to allow for 25 per cent. shrinkage.

Most of the grafts were taken from the abdomen, but of necessity came from the thighs or sides, and two were taken from the back. No attention was paid to matching the direction of the cleavage line of the skin, though possibly this might in some way have some influence. It seemed that the thin skin "takes" more kindly than thick.

Seven of these grafts were taken from the scalp to replace lost eyebrows, and we have in some cases, not included in the above series, transplanted free grafts from the eyebrow to replace eyelashes. In replacing eyebrows the scalp rather than pubic skin has been used for the reason that the hair on the former

FIG. 16.—(a) Shows a lady on whom the nose and upper lip were remade from a flap taken from the neck and the tissue behind the ear. (b) This was replaced with a full thickness skin graft from the abdomen. In this case the "take" and texture were very good but the skin grafted is very much whiter than that of the neck. (c) Shows a young woman who, on account of a recurrent carcinoma, had part of cheek and upper lip reconstructed from a delayed flap taken from the forehead. The forehead defect was filled by a full thickness graft from the abdomen, satisfactory in "take" and texture but which has become very darkly tanned. The girl is naturally of a dark swarthy complexion (d).

grows more closely and an accurate selection can be made as to the direction in which the hairs grow. It is true that the hair on a scalp graft must be trimmed at intervals, but that might be true of pubic hair, and the plan of growth of the latter resembles eyebrow less than does the scalp hair. Law, of Minneapolis, has mentioned one case in which an otherwise successful pubic graft had to be removed on account of embarrassment arising from the self-consciousness of the patient.

Its Place in Surgery.—The four most appropriate uses we have found for the free full thickness skin graft are the release of scars on the neck and axillæ, the replacing of burn scars on the hands, neck and forearms, to replace flaps that have been taken to repair other defects and to furnish skin to line clefts in congenital or acquired syndactylism.

In these uses it can be compared with the pedicle flap and the "Thiersch" graft about as follows: The former when properly handled is more certain to complete success, and if taken from the neighborhood is apt to have a better color. Where subcutaneous tissue is also desired, as over the bearing surface

FIG. 16.

of a bone that is covered only by scar, the pedicle graft is more appropriate. The final result of the pedicle flap is often greatly compromised by the excess of subcutaneous fat that is included. This is most noticeable with flaps transplanted to the hands or fingers. The question of the possible subsequent increase of fat in the transplanted flap concurrent with a later general increase of the fat has not, as far as known, been settled. The "Thiersch" graft is also more certain of taking, the technic of its use is less exacting, and it can be applied within the mouth as well as on a clean skin surface. On the other

FIG. 17.—(a) Shows appearance of child shown in Fig. 18 after 50 per cent. of the first graft had healed in place. (b) Shows the case after a second strip of skin had been recently grafted above the upper edge of the first. The completion of this case is shown in Fig. 18 (b).

hand, its subsequent contraction is many times greater than a successful Wolfe graft and its color and appearance is not as good.

The full thickness graft is somewhat uncertain of result, is exacting in its technic, requires three weeks before it can be considered safe, and in children and young adults may develop red corded scars, months after an apparently perfect take, yet it has a place in surgery that is not as well filled by either of the two preceding.

The Technic.—The technic was as follows: The graft is usually implanted either in the bed from which a flap or a scar or growth has just been removed, or in the space that results where a tight area of skin or scar has been incised and released. The bleeders are caught and, where practicable, tied with fine silk, preferably white. A pattern accurately reproducing the shape and size of the raw surface is cut from a piece of sterile tin-foil and the side corresponding to the epithelial surface is indicated by writing on it with a blunt instrument the name and date. This has proven to be important. The skin from which the graft is to be cut is painted with 5 per cent. picric acid in alcohol which is later sponged off with alcohol. The tin-foil pattern is laid

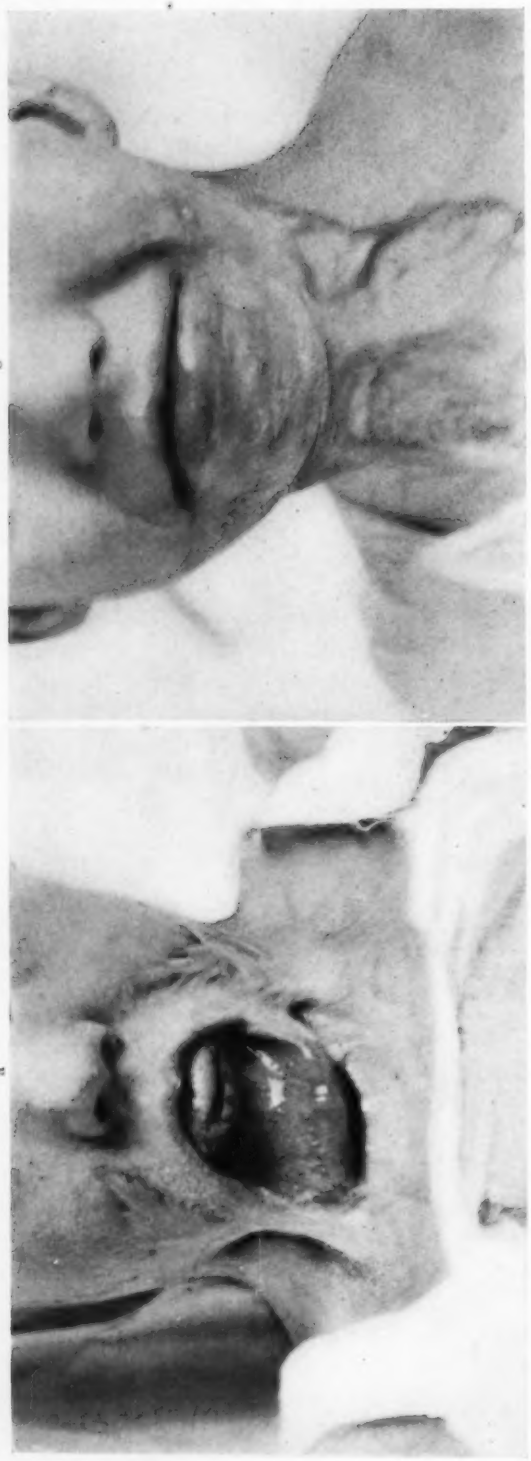


FIG. 18.—Shows a child who as a result of severe burns had the mucosa of the lower lip attached to the chest 1 inch below the upper border of the sternum. It required three separate operations to obtain the result shown in (b). At each of these operations full thickness grafts from the abdomen or thigh were implanted. A total of 50 square inches of skin being transplanted. Eighty per cent. of which "took"—color good.

on the skin, epithelial surface up, and the outline very accurately marked by a knife cut which immediately, or later, is made to go through the full thickness. Allis or small Ochsner forceps grasp at intervals along the edge of the skin at the end of the outlined graft, while with a very sharp knife the skin is released from all subcutaneous vessels and tissues, cutting always where the junction of the skin with the subcutaneous tissue is most tense. The under surface of the skin should show white and stippled with little pits and should show no bleeders. The graft is given in charge of an instrument nurse who places it in a pan, folding it so that raw surface is to raw surface and the whole covered with damp gauze. When it is to be used one assistant grasps an edge with an Ochsner or Allis forceps and is responsible for it until the graft is safely tacked in place. This bit of formality may save the embarrassment of losing the graft among the discarded sponges or of dropping it on the floor.

The graft is usually punctured and then

sutured into its new bed with a continuous horse hair, first tacking it in a few places to assure accuracy of position and even tension. If the vessels of this bed have not been tied, as may be the case in a burnt area, bleeders must be controlled between the removal of the forceps and the application of the pressure dressing by sponge pressure or an Esmarch bandage. Just before the final dressing is applied the clots are pressed from under it by firmly rolling

FIG. 10.—Shows a child on whom a scar of the lower lid and cheek, due to congenital infection, was replaced by a full thickness skin graft from the abdomen. In order to hold the denuded lower lid on tension while the graft was healing in place, a small raw surface was made in the middle of the upper lid just above the tarsal border and a projecting tab of graft was made to jump the palpebral fissure, tarsal border and eyelashes to be planted on the upper lid. This strip of graft "took" perfectly and can be seen in the figure. The part included within the dotted outline in (a) shows the amount of scar actually removed while the everted mucosa above this was undermined and turned upward, thus increasing the raw surface to be grafted to the extent shown in the striped area. A superficial ulceration caused the subsequent loss of some epithelium with a resulting excessive contraction of the graft, which necessitated the subsequent addition of a pedicle flap from the forehead to the lower lid. Finally the skin bridge across the tarsal fissure was cut and the piece removed from the upper lid.

over the surface a roll of gauze, the surface is then covered with several layers of gauze impregnated in 3 per cent. xeroform ointment. Over this is applied a large soft, damp marine sponge which is bandaged in place with some pressure. The quality of the sponge and the tension on the bandage are important factors.

If the vessels have not been tied and the bandage pressure is depended

NOTE.—We use a good quality of bath sponge which when dry is about 1½ inches thick by 4 x 5 inches in diameter. These are washed, soaked in an antiseptic, rinsed, dried, and put away in a jar. When to be used they are wet with saline and wrung out as dry as possible in a towel. Sponges may be cleansed and used repeatedly, but when they lose their elasticity they must be discarded.

upon to control the bleeding, it is well to put an inner bandage over the sponge at the tension it is desired to maintain until the first redressing, and over this place a much tighter bandage that is to be removed in three or four hours.

a

b

FIG. 20.—(a) Taken on the 12th day after operation shows a full thickness graft that was practically perfect at that date. Up to this time the graft had been dressed with xeroform ointment on the gauze. The ointment was left off and a dry dressing was applied for but 24 hours. (b) Shows the same graft one week later. A superficial ulceration has spread over about one-half the surface and in two small areas has gone completely through the epidermic layer. A 2 per cent. boric acid, moist pack, frequently changed, was used which controlled this superficial infection. The xeroform or the boric acid may be of some help, but what really accomplished the result is the ointment or the wet pack which prevents the formation of crusts that harbor bacteria. The discolored appearance in (a) is due to xeroform, which turns dark after a few days.

The sponge pressure of the permanent dressing should be firm but not sufficient to cause ischæmia of the graft. One's surgical sense may be severely taxed in figuring this out. Blood seeping into the sponge can make the pressure greater than it was when the bandage was applied. All gauze

dressings should be laid on smoothly, the sponge should be soft and the gauze not wrinkled during the bandaging, as patterns of damaged epithelium have been observed that seemed to correspond to wrinkles in the gauze dressings.

The space that furnished the graft may be treated in one of several ways. At first we excised the fat, undermined the edges and obliterated it with sutures. This causes additional bleeding and delay, and should the sutures not hold the scar will be fixed to the aponeurosis or muscles. Now we simply approximate the borders with silkworm gut and either plicate the raw surface with the suture or undermine the edges by thrusting a dissecting scissors and opening them as they are withdrawn. This causes little bleeding. It is always safe to drain the wound at intervals. If the defect is too large to close, it is "Thiersch" grafted from the thigh with or without encircling it with a purse-string suture.

If satisfied as to the asepsis, the original dressing can remain undisturbed for three weeks, but usually it is safer to look at a graft on the young child or infant in five or six days and the adult's in seven or nine days after operation. If the pressure dressing is for any reason removed before these dates, it should be replaced in the same manner as at the original operation. Where mouth secretions or vomit are apt to soil the dressings, a dam composed of rolls of vaseline gauze may be plastered to the lip at the edge of the dressing. Leaving off the pressure dressing at too early a date favors the formation of blebs, which in turn predispose to ulceration of the epithelium. The base of blebs that have or threaten to become infected are painted with 1 per cent. silver nitrate once a day and a xeroform ointment dressing applied. It is not safe to use a dry dressing. The dressing problem is very much simpler if the child has not been hurt by pulling off dressings that have stuck. Of late, as already stated, a boric acid pack has been used for the later dressings on infected cases which seemed to clear off the slough and stop the infection quicker than did the silver and ointment. If a moist dressing is used, it must be kept moist. Lost areas of epithelium can be replaced with "Thiersch" graft put on under pressure as soon as the slough and infection have cleared up.

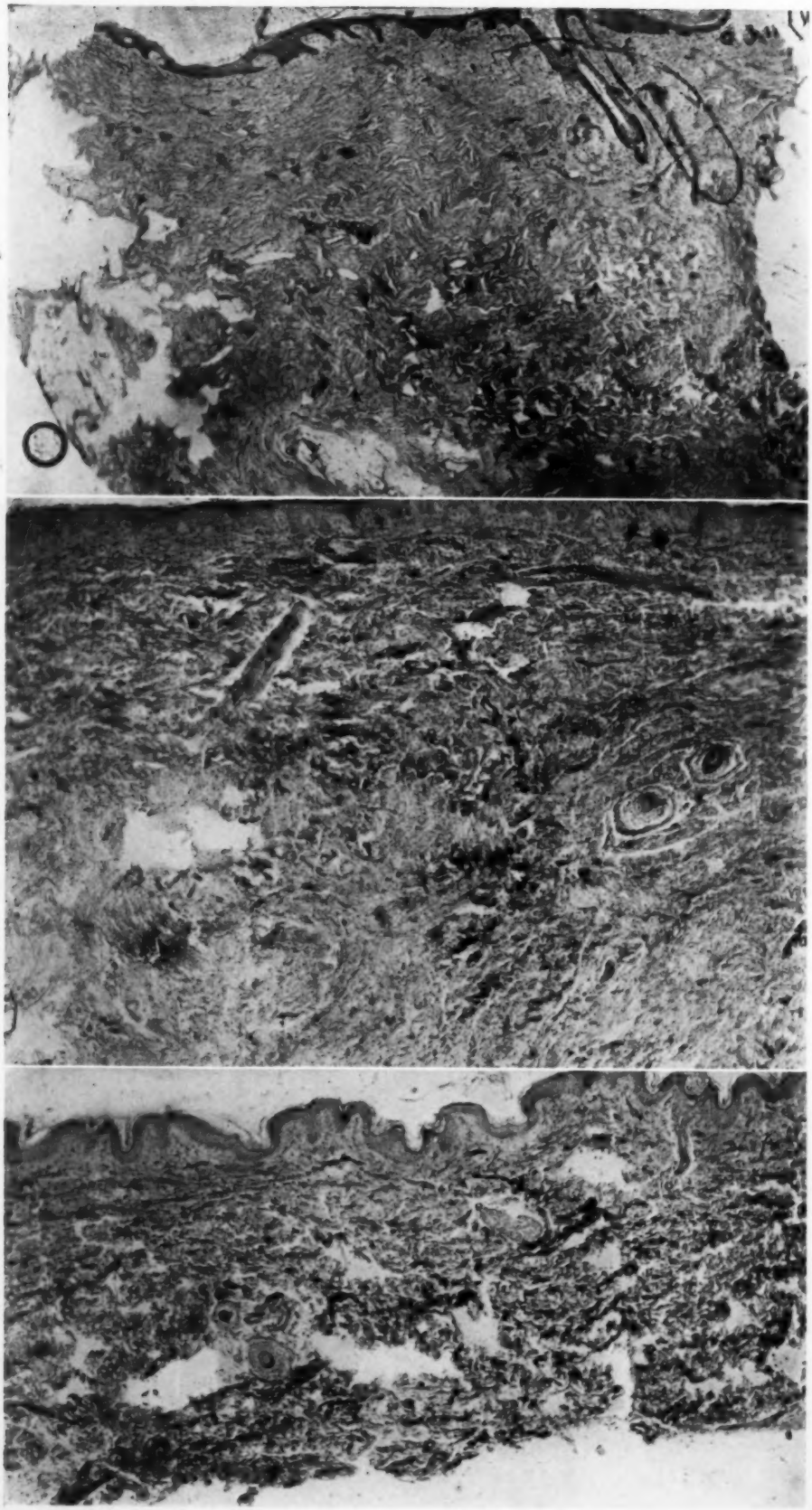

a
b
c

FIG. 21.—Histology of Auto Grafts of Skin.—In making a study of the histology of skin grafts Dr. Earl C. Padgett found that the most complete, recent report was from "Transplantation of Tissues," by Harold Neuhof, D. Appleton & Company, 1923, and is taken to be a résumé of the present ideas in regard to microscopic appearance of transplanted skin. He states that within five or six hours after transplantation there is an exudate of fibrin from the wound fixing the transplant in place. This fibrin layer soon becomes infiltrated with leucocytes and fibroblasts and disappears gradually to be replaced by a richly vascular connective tissue containing many round cells. The granulation tissue has changed into an organized membrane at about fourteen days. Within a few hours after the graft has been applied, leucocytes of the fibrin layer migrate into its interstices and are also to be found in the lumina of its empty blood-vessels. Most of the blood-vessels in the transplant degenerate. By injection experiments vessels have been demonstrated in cutis grafts on the third day. The newly built vessels arise by a budding of the capillaries in the fibrin layer, and the buds not infrequently extend directly into the vessels of the graft. Degenerative processes set in so that on the third or fourth day the epidermis with the upper rate layer of the skin are lost. The degenerative processes are pronounced at an early stage so that there is a vacuolization of the surface of the graft, hand in hand with the degenerative processes, regeneration goes on and it is usually so energetic that in six or eight days the entire transplant is covered with new epithelium. The degeneration extends beyond the epithelium to the cutis. The entire cutis is replaced by granulation tissue which in time shows a decrease in cells and blood-vessels and an increase in fibrous tissue. According to this, histologic examination established viability only, and this solely in the juxta-epithelial layer of the graft. The histologic changes in the whole thickness grafts do not differ materially from those occurring in the "Thiersch "grafts. The epithelium is slower to regenerate in full thickness grafts by a few days. Doctor Padgett's study of sections from our own cases does not show as much degeneration of surface epithelium nor of the cutis and corium. Sections taken from grafts which have good color show only a very superficial degenerative change in the outermost layer of epithelial cells, and when this layer is removed it leaves a skin which is a little more pink but otherwise normal in appearance, and microscopically the squamous cells appear a little œdematous and swollen. Evidently only the most superficial epithelial cells degenerate on good grafts. He does not believe that our sections show either as much degeneration of the squamous epithelial layer or of the cutis and corium as is usually described. The older grafts on inspection look rather normal in texture but a very pale tan with little suggestion of the normal pink of the surrounding skin. Histologic studies were made of approximately twenty grafts of this series varying from eight days to two years after implantation. The most noticeable change that occurs in the microscopic anatomy of an old full thickness graft is a smoothing of the surface best appreciated when a section of the graft is compared with a section taken from the site that furnished the graft. The papillary layer of the epithelium appears to be about normal except that it follows the flat contour of the surface. Elastic tissue appears to be present in about normal quantity. Fig. 21c, is the abdominal skin taken from alongside of the scar which resulted from removing the graft shown in Fig. (b). Note the surface irregularities. Fig (b) shows a section of the graft twenty-two months after it was implanted in the forehead, where it "took" without any hesitation or any evident loss of epithelium. In Fig. (a) the papillary layer is brought out with more contrast. This is a section from a graft on the forehead of a six-year old boy done eight months previously, which has the same general appearance as the graft b. Note the hair follicle and gland remnant and the same absence of the normal surface irregularities that is to be observed in b.

TABLE I.

In Twelve Cases in This Series, 50 Per cent. or More of the Surface Area was Lost. The Table Below Gives Details of These Twelve Cases.

Source, location and reason for graft—Age of patient	Apparent cause and circumstances of loss	Remarks	Size of graft in sq. inch	Per cent. of graft lost	Final disposition and results
Abdomen to forehead to replace delayed flap in two month old infant	Graft came off at first dressing with no evidence of ever having adhered. Infection of bed due to contamination at operation and low resistance	After first of a series of operations for oblique facial cleft, child had diphtheria in affected eye; later pus infection of the deformed lacrimal sac which was removed. Of necessity the operation was resumed several weeks later. The conjunctiva became infected, the flap but partially adhered and an abscess developed in other side of neck.	3	100	Raw area allowed to granulate—it will contract enough to allow the scar area to be entirely replaced by the pedicle of the flap when the latter is returned to forehead.
Abdomen to forehead to replace delayed flap on young woman	Graft came off at first dressing with no evidence of ever having adhered. Infection of bed due to operative contamination and low resistance	Graft was applied two weeks after a severe tonsillitis in a series of operations that could not well be interrupted	6	100	Thiersch grafted granulating area later which "took" satisfactory and made fairly satisfactory final result.
Abdomen into floor of mouth through clean wound in neck in adult man	Most, if not all, of the graft was lost from maceration and infection due to lack of ventilation and impossibility to carry out routine after-treatment	This graft was sutured around a wax form at normal tension and buried under scar in the floor of mouth that remained after hemi-excision of tongue. The incision was made from the neck and was presumably clean. Esser technic.	3	100	Later, the tongue was again freed and an inlay. "Thiersch" graft applied. Final result 50 per cent. satisfactory.
Abdomen to forehead to replace delayed flap in fourteen year old girl	Infection of the graft which started in the epithelial surface after the graft had become adherent and before the original dressing was changed. Possibly due to operative contamination and low resistance	This child has been through a long series of operations to replace cheek, floor of orbit, lower eyelid and half of nose and upper lip lost from noma. She is a subject of low resistance and has reacted poorly after each operation and has had several infections during this period ranging from tonsillitis to hæmolitic streptococcus of the conjunctiva. An earlier first dressing might have saved much of this graft.	11	90	The granulations and remaining part of the derma were successfully covered with "Thiersch" grafts later. Fairly satisfactory final result. At another time she had a successful full thickness graft applied to the other side of forehead.

Abdomen to cheek to replace burn scar on young man	Graft appeared perfect at first dressing, two days later when pressure dressing was left off to avoid its contamination with saliva, flap became blue and ultimately died from blood stasis in spite of oft repeated scarification and citrate of soda packs	Where this pack rested on the body of the mandible some of the graft was preserved. It was the experience with this graft that suggested the necessity for the longer retention of the pressure dressing	12	70	Was regrafted, full thickness graft after slicing off granulations 36 days later. This second graft contained less than five square inches of skin
Abdomen to front of neck to release burn scar on fourteen year old girl	Graft became attached but on the day after operation certain areas appeared to be without elasticity; on cutting it was found the skin was dead. The slough was gradually thrown off (see Fig. 5). Necrosis apparently due to too firm pressure	This was one of the early cases in the development of the pressure dressing. The sponges were bandaged in so tight that the face was congested. Pressure over the upper part of the larynx is particularly apt to kill the graft in this situation.	32	70	Regrafted at a later date when raw areas had scarred up.
Abdomen to cheek, nose, lower lid and upper lip to replace burn scar on two year old infant	Graft was compressed with a rubber bath sponge. Death seemed to be due to maceration caused by lack of ventilation and subsequent infection	This was one of the several grafts which were covered by a more or less impervious dressing all of which macerated to a greater or less extent	2	70	Area covered with a pedicle flap from forehead at a later operation.
Abdomen to lower eyelid, cheek and side of nose on seventeen year old retarded child due to a congenital infection	Graft adhered throughout but about half was lost apparently from superficial infection becoming active in the second week	In this case the vesicated areas were painted once a day with 1 per cent. silver nitrate in alcohol and it was thought this might possibly have helped to damage the epithelium. The graft contracted somewhat less than one-half its original area	3	50	Eyelid later restored with pedicle flap graft. The graft itself is a little glazed.

TABLE I.—*Continued.*

In Twelve Cases in This Series, 50 Per cent. or More of the Surface Area was Lost. The Table Below Gives Details of These Twelve Cases.

Source, location and reason for graft—Age of patient	Apparent cause and circumstances of loss	Remarks	Size of graft in sq. inch	Per cent. of graft lost	Final disposition and results
Abdomen to cheek to replace burn scar in a six year old boy	About one-half the graft became necrotic roughly corresponding in area to the body and ramus of jaw and zygoma but it was firmly attached at first dressing	Slough was finally thrown off—in places leaving granulations, in others a stippled base. The behaving and distribution of the dead skin seemed to indicate that too much pressure has been used. Note that in case No. 5 of this series where a very loose dressing was used that part of the graft overlying the bone was the only part saved	12	50	Scarred up and made a fairly good final result with all distortion relieved. The scars are red and rough but time will largely correct this.
Abdomen to front of neck to replace burn scar on nineteen year old girl	At first dressing, 9th day, a necrotic area was discovered over the upper part of the thyroid while the "take" lower down and in submental and submaxillary regions was perfect. Too great pressure and too much movement	On cutting into dead area two things were observed: first, that part of the dead graft in front of the pomun adami and thyrohyoid membrane was not adherent but surrounding this was a ring of dead graft that was adherent to the deeper tissue. Second, that a narrow bridge of live skin spanned the central part of this unattached and otherwise dead area	7	50	Allowed to scar. Provision for loss had been planned for in the cutting and suturing the graft.
Abdomen to palm of little finger for burn scar in a young woman	Implanted partly on scar. Considerable superficial loss and contraction. Cause not very evident		1	50	Some flexion of the finger remained.
Abdomen to front of neck to release scar on six year old child	Dressed 5 days after operation much of graft macerated due to poor ventilation and infection	In this case the bandages over the marine sponge were daubed with vaseline to prevent possibility of vomit getting into sponge	22	50	Additional grafts added after healing.

ENDOANEURISMORRHAPHY*

PERSONAL EXPERIENCE IN 21 CASES

By John H. Gibbon, M.D.

of Philadelphia, Pa.

It has been twenty years since Matas presented a new and very rational method of treating accessible aneurisms, with a report of four cases, and in his last communication (Résultats immédiats et éloignés de la Cure des Anévrismes—La Presse Médicale No. 10, du 3 Février, 1923) he states that 350 endoaneurismorrhaphies have been reported, including 59 of his own. though this figure does not, of course, represent all the cases operated upon by this method, it seems, nevertheless, too small a number, particularly when one considers the great number of traumatic aneurisms which must have resulted from wounds of the blood-vessels in the late war. From personal observation and verbal reports I know that many ligations were done for the cure of these aneurisms where endoaneurismorrhaphy would have better served the purpose, in view of the fact that before the war enough cases had been reported to show that the Matas operation resulted in a lower mortality, a higher percentage of cures than the old ligation methods, and that it had practically eliminated gangrene, which under the most favorable circumstances followed the ligation of large arterial trunks in a certain percentage of cases.

Sencert, of Nancy, in his book on "Wounds of Vessels" (University of London Press, Ltd., 1918) recommends extirpation, rather than ligation, in traumatic aneurism, and it seems to have been the method preferred by most French surgeons during the war. He says that gangrene is less frequent after extirpation than after ligation. In 93 cases of extirpation, which he collected from French and foreign literature during the war, gangrene followed in nine cases. In the British Service, ligation was the operation of choice. The Germans practiced suture of the injured vessel rather than ligation more extensively than the Allies, and they also utilized the intrasaccular ligation (the passing of a suture through the sac wall and about the artery) in aneurisms, where the restorative operation of Matas could not be done. Matas (Keen's Surgery, Supplementary Volume, 1921) says they used the restorative operation in about 50 per cent. of the saccular aneurisms. Most of the German surgeons gave up the extirpation of the sac in favor of the above-mentioned methods. It is impossible here to discuss in more detail the wide difference of opinion held by surgeons of the different countries in regard to the treatment of traumatic aneurisms, but the whole question, including the immediate treatment of wounds of the vessels, is thoroughly discussed by Matas in Keen's Supplementary Volume, published in 1921. I am convinced that the principles laid down by him are applicable to trau-

* Read before the American Surgical Association, April 18, 1924.

matic, as well as syphilitic, aneurisms, and it is to be regretted that more endoaneurismorrhaphies were not done during the war.

These observations have caused me to feel that an additional report of my personal experience may be timely and might prove the means of stimulating others to deal with aneurisms from within the sac and abandon ligation, which, though easier to do, carries with it a higher mortality and a smaller chance of cure.

I reported my first experience with the Matas operation in 1904 (American Medicine, August, 1905), and my second in 1907 (ANNALS OF SURGERY, September, 1907), and in 1912 I presented a summary of my experience in eight cases (Jour. A. M. A., July 27, 1912). Since the publication of this paper I have operated upon 13 additional cases, bringing the total up to 21 cases. It might be added that no ligations for the cure of aneurisms have been done during the past twenty years, except for hemorrhage and except in aneurism of small vessels, such as the temporal and radial. I have also done one successful invagination operation on a small traumatic aneurism of the common carotid.

Of the total of 21 Matas operations, I would like to exclude from the present discussion one case of aneurism of the abdominal aorta, already reported, and one of the splenic artery, and consider only the remaining 19, all of which had to do with what are generally considered accessible aneurisms. Of these 19, there were 6 popliteal, 10 femoral, 2 femoral and external iliac, and 1 brachial. Six were traumatic and 3 of these were arteriovenous.

Deaths.—There were three deaths following operation; one was an anæsthetic death just at the conclusion of the operation; one occurred fifteen days after operation and twenty-four hours after a ligation of the femoral artery for secondary hemorrhage from the site of an obliterated popliteal aneurism. The patient was in good condition following ligation and died very suddenly the next day; the autopsy showed a vegetative endocarditis and splenic and renal infarction. The third death was in an extremely ill luetic negress with a femoral aneurism. The operation was done under local anæsthesia because of the patient's very grave cardiac condition. One week after the operation she had a hemorrhage from the site of operation, which was controlled by re-opening and re-suturing. She died suddenly the next day without any more bleeding or any symptoms indicating impending death. The autopsy findings in the case history, No. XV, I think show several sufficient reasons for her death.

I probably ought to say that one of my early cases of popliteal endoaneurismorrhaphy died of uræmia two months after operation, when his wound was healed. This man, a luetic, had chronic Bright's disease at the time of operation and local anæsthesia was employed. Therefore, it is not likely that the operation hastened his death.

In reviewing these deaths I do not think, with the exception of the second, that they can be attributed directly to the operation, or that any different

results would have followed ligation. Two of the three patients had far advanced syphilis, lesions of the heart, aorta and viscera.

Hemorrhage.—In addition to the cases above mentioned, second hemorrhage occurred in two others, both traumatic femoral aneurisms. In one the bleeding occurred two weeks after operation, when the wound was well healed. It was controlled by re-suturing, but recurred four days later and a ligation of the femoral was done. The patient made a good recovery. In the second case, an enormous arteriovenous aneurism, bleeding occurred three weeks after operation, due to late infection, which I am sure resulted from the injudicious insertion of a soft rubber drain two weeks after operation because of a superficial collection of serum. Re-suture was done in this case also, but bleeding recurred and ligation of the femoral was done. This patient made an excellent recovery.

It will be noted that the bleeding in all these cases occurred from one to three weeks after operation. I think that secondary ligation two or three weeks after operation carries with it practically no danger of gangrene, as the collateral circulation is by this time well established.

Gangrene, Amputation and Secondary Aneurism.—There has been no gangrene and no amputation in any of these cases, including the fatal ones, and in this connection I would call attention to the fact that ten were aneurisms of the femoral and two of the femoral and external iliac. There has been no secondary aneurism. These results should be compared with 10 per cent. of gangrene in the 93 cases of extirpation reported by Sencert.

Results.—The 16 cases which survived operation have nearly all been traced, as shown by the case reports, and none have had any recurrence or any circulatory disturbance.

Technic.—It must be apparent that the treatment of aneurisms, resulting from disease of the blood-vessels, is different from that of those caused by direct injury of the vessel. In the case of the diseased vessel, the patients are practically all syphilitics, have more or less advanced disease of the heart and aorta, and often have liver and kidney lesions. In these cases far better results will be obtained if operation is preceded by an intensive anti-syphilitic treatment, including large doses of the iodides. The pain and the growth of the aneurism can be fairly well controlled by complete rest in bed and the constant application of an ice bag over the aneurism. It has been our rule to keep up the use of mercury and iodides after the operation. Some of our cases have easily taken 200 to 300 grains of potassium iodid a day. The improvement which takes place during this preliminary treatment has been quite remarkable in a few cases and it certainly has reduced the operative risks.

In these cases, too, I would urge that the control of the circulation should only be made by digital compression. Temporary ligatures or rubber-covered artery clamps for the control of the vessel above the aneurism are likely to so injure it as to cause the subsequent development of an aneurism at the site where they have been applied. Such cases have been reported, just as they have after permanent ligation of the artery for the

cure of aneurism. For this reason, too, the tourniquet has not been used in our recent cases, although with it the risk of damage to the vessel is not so great. Digital compression of the vessel by an intelligent assistant is quite reliable, has only to be kept up for the few minutes it takes to empty the sac and to find and close the large openings into it. In the high femoral and the femoro-iliac aneurisms, the abdomen has been opened and the common iliac compressed by an assistant. These precautions are not necessary in the traumatic aneurisms, but even in these cases I think the temporary ligature should be avoided, though the tourniquet or rubber-covered clamps may be employed. Elevation of the extremity for a few minutes before the sac is laid open will do a good deal to conserve blood. In none of the cases here reported has the amount of blood lost at the operation been sufficient to affect the patient's general condition.

In all the aneurisms, due to disease of the vessel, I have done the obliterative operation. In most of the traumatic aneurisms and in the three arteriovenous aneurisms, the restorative type was done. I have not done the reconstructive operation and I have doubted its applicability, except in rare instances of traumatic aneurism, where a large part of the vessel wall is normal. In two cases of arteriovenous fistula, one of the brachial and one of the femoral vessels, the opening in the artery was closed, the vein ligated and a portion of its wall used to reinforce the closure of the artery.

I have come to the conclusion that catgut is the best material to use for closing the openings into the sac and for its obliteration, although I used linen thread for the deeper sutures in my earlier cases.

I have never used the mattress sutures through the skin to aid in obliteration of the sac, as was suggested by Matas in his original paper, because I thought that a suture passing through the skin and into the sac might be the means of causing infection.

Infection is a serious complication and may readily lead to secondary hemorrhage. This was certainly true in one of our cases, an enormous arteriovenous aneurism of the femoral vessels. One of the most important measures to take in order to avoid infection is complete hæmostasis within the sac and its complete obliteration. Pockets, where blood and serum accumulate, are dangerous foci of infection. Another source of infection is any kind of a drain, even the subcutaneous type. In order to prevent any subcutaneous accumulation of serum, it is better to leave considerable space between the skin suture than to use a drain, even for twenty-four or forty-eight hours. If any superficial infection should occur, the skin sutures should be promptly removed and no drain used. In the syphilitic cases I formally used a superficial drain, but considerable experience in war wounds has caused me to abandon the practice, as it is more apt to cause, than prevent, infection.

In arteriovenous fistula the artery and vein are always densely adherent for a considerable distance above and below the point of communication and their separation is tedious and difficult. In these cases it seems better to ligate the vein below and above the opening, without attempting separation from the

artery, then to open the vein, with the arterial circulation controlled, and suture the opening into the artery. The vein wall between the ligation can then be used to reinforce the arterial closure. In one of my cases a large tributary vein opened into the involved vein between the ligatures and, should this occur, the tributary vein should be ligated beyond the main vein.

In the true arteriovenous aneurism it is unnecessary, I think in most cases, to dissect out the vessels above the aneurism. A tourniquet should be applied, the sac opened and the necessary occlusion done from within the sac.

I am inclined to believe after this review of my personal experience that the Matas operation is indicated in all accessible aneurisms, and that it should supplant ligation, because its dangers are less and permanent cure is more assured.

The following is a brief synopsis of our 21 cases. The first eight cases were reported in more detail in 1912:

CASE I.—Negro, male, aged thirty-one years. Pennsylvania Hospital, operation September 29, 1904. Syphilitic. Popliteal aneurism. Esmarch constrictor. Obliterative operation. No drain. Superficial infection. Eight years later patient was perfectly well.

CASE II.—Physician, aged fifty-seven years. Bryn Mawr Hospital, operation November 24, 1906. Syphilitic. Popliteal aneurism and advanced Bright's disease. Local anæsthesia and a little ether. Esmarch constrictor. Obliterative operation. Complete obliteration impossible; packing used. Wound healed by granulation. Patient died two months after operation from uræmia.

CASE III.—Negro, male, aged thirty-eight years. Pennsylvania Hospital, operation November 27, 1907. Large femoral aneurism. Probably not syphilitic. Digital compression of femoral, after exposure. Obliterative operation. Superficial drain. Slight infection. Discharged with healed wound January 4, 1908. Letter received five years later reported patient perfectly well.

CASE IV.—White, male, aged forty-four years. Jefferson Hospital, operation December 7, 1907. Large traumatic femoral aneurism. Esmarch constrictor. Obliterative operation. Patient died three years later from tuberculosis without any further trouble from the aneurism.

CASE V.—White, male, aged forty-five years. Jefferson Hospital, operation September 13, 1908. Aneurism of abdominal aorta, complicated by anuria, which suggested an aneurism of the renal artery. Symptoms suggestive of rupture on day previous to operation. Aorta controlled by rubber catheter and obliterative operation done. Patient died on the table.

CASE VI.—White, male, aged forty-six years. Pennsylvania Hospital, operation January 11, 1911. Popliteal aneurism. Esmarch constrictor. Obliterative operation. Superficial drain. Slight discharge from wound. Quite well eighteen months after operation.

CASE VII.—White, male, aged thirty-six years. Jefferson Hospital, operation July 12, 1911. Aneurism of femoral and external iliac (syphilitic). Abdomen opened and common iliac controlled by digital compression. Obliterative operation. Patient examined eight years after operation; excellent result; no symptoms.

CASE VIII.—Negro, male, aged thirty-six years. Jefferson Hospital, operation June 1, 1912. Popliteal aneurism (syphilitic). Esmarch constrictor. Obliterative operation. Anæsthetic death, as skin sutures were being introduced. Autopsy negative except aortic atheroma.

CASE IX.—Negro, male, aged thirty-two years. Pennsylvania Hospital, operation November 8, 1916. Femoral aneurism (syphilitic). Abdomen opened; digital compres-

sion of external iliac. Obliterative operation. Superficial infection. Discharged January 11, 1917; wounds healed.

CASE X.—White, male, aged twenty-six years. Jefferson Hospital, operation January 6, 1917. Popliteal aneurism (syphilitic). Confined to bed for six months. Digital compression of femoral without exposure. Local anæsthesia and a little ether. Obliterative operation. Secondary hemorrhage. Ligation of femoral under local anæsthesia two weeks after operation. Died suddenly next day. Autopsy findings: hypertrophy and dilatation of heart; fatty degeneration; acute vegetative endocarditis; splenic and renal infarction; red atrophy and fatty infiltration of liver and atheroma of aorta.

CASE XI.—White, male, aged eleven years. Jefferson Hospital, operation April 3, 1917. Traumatic femoral aneurism; three years' duration; gunshot wound. Digital compression of femoral without exposure. Restorative operation. Two weeks after operation with wound healed without infection bleeding began. Re-suture and transfusion. Bleeding began four days later and femoral ligated under local anæsthesia. Discharged with wound healed and pulsation in posterior tibial May 24, 1917. April 28, 1924, letter reports patient perfectly well; "cannot tell one leg from the other," and plays football.

CASE XII.—White, male, aged twenty-six years. U. S. Base Hospital No. 19, London, November, 1918. Traumatic femoral aneurism. Shrapnel. Restorative operation. Healed without infection. Evacuated to United States. Letter received April 19, 1924, reports no further trouble from aneurism.

CASE XIII.—White, male, aged twenty-six years. Pennsylvania Hospital, operation November 20, 1920. Arteriovenous aneurism of brachial vessels. Machine-gun bullet two years previous. Vein ligated above and below. Artery controlled by rubber-covered clamp compression. Restorative operation with reinforcement with section of vein. Discharged with wound healed. Unable to trace.

CASE XIV.—Negro, male, aged forty-seven years. Pennsylvania Hospital, operation November 30, 1921. Popliteal aneurism (syphilitic). Esmarch constrictor. Obliterative operation. Examined two years later; no further trouble from aneurism, but has cardio-renal disease.

CASE XV.—Negress, aged twenty-three years. Pennsylvania Hospital, operation December 21, 1921. Femoral aneurism (syphilitic). Acute endocarditis; fever; delirium; symptoms of splenic infarction. Improvement under anti-syphilitic treatment. Very bad operative risk. Local anæsthesia. External iliac exposed. Digital compression. Obliterative operation. Bleeding seven days later. Re-suture under gas anæsthesia; no more bleeding. Died suddenly next day, when apparently in good condition. Autopsy findings: acute and chronic endocarditis and aortitis; hypertrophy and dilatation of left ventricle; infarction of spleen and kidneys; atrophic cirrhosis of liver and vesicular emphysema of lungs.

CASE XVI.—White, male, aged twenty-seven years. Pennsylvania Hospital, operation September 27, 1922. Arteriovenous fistula of femoral vessels; gunshot wound twenty-six days previous. Esmarch constrictor. Restorative operation. Vein ligated and portion used to reinforce closure of artery. Prompt healing. Examined and found in good condition some weeks after discharge, but unable to trace since.

CASE XVII.—White, male, aged thirty-five years. Jefferson Hospital, operation October 16, 1922. Enormous arteriovenous aneurism of femoral vessels. Stab wound, with scissors, four months previous. Esmarch constrictor. Restorative operation done on both vessels. Wound healed primarily. Two weeks later some serum evacuated and, without instruction, a drain inserted. Later infection and bleeding. Sac re-opened and bleeding vein sutured. No bleeding from sites of previous suture. Wound packed open because of infection. Transfusion. Bleeding occurred at the end of week and again controlled by suture within the contracted sac. Another hemorrhage a few days later. Ligation of superficial femoral. Made good recovery and is now perfectly well.

CASE XVIII.—Negro, male, aged thirty-five years. Pennsylvania Hospital, operation November 14, 1922. Popliteal aneurism (syphilitic). Digital compression of femoral

without exposure. Obliterative operation. Returned to work in post office two months after operation and was without symptoms and still working, November 14, 1923, one year after operation.

CASE XIX.—Negro, male, aged fifty-one years. Pennsylvania Hospital, operation January 9, 1923. Aneursim of femoral and external iliac (syphilitic). Extended up to within two inches of umbilicus. Abdomen opened and abdominal aorta controlled by digital compression. Obliterative operation. Discharged March 3, 1923, with wound completely healed. April 21, 1924, has had no further trouble.

CASE XX.—White, male, aged fifty-four years. Jefferson Hospital, operation March 5, 1923. Aneurism of splenic artery. Not(?) syphilitic. Pre-operative diagnosis, upper abdominal tumor, probably retroperitoneal. Mass found attached to tail of pancreas, which was thought to be a cyst. No pulsation. During separation, rupture occurred with profuse bleeding and evacuation of clots; finger introduced into sac; discovered opening of vessel and bleeding was easily controlled while quantities of clot were evacuated. The arterial opening into the sac was closed by suture and the sac obliterated. Patient was in good condition the next day, but then developed a broncho-pneumonia and died on the third day, with a high temperature. He had no symptoms of bleeding and no abdominal symptoms. Autopsy findings: aneurism of splenic artery; no blood in abdomen and no peritonitis; marked fibrosis of aorta; sclerosis and dilatation of left common iliac; acute suppurative bronchitis and early broncho-pneumonia. Wassermann from heart blood negative.

CASE XXI.—Negro, male, aged forty-five years. Jefferson Hospital, operation April 23, 1923. Femoral aneurism (syphilitic). Abdomen opened and common iliac controlled by digital compression. Obliterative operation. Patient examined in November, 1923, and there was no evidence of recurrence and he had no pain in leg.

CIRSOID ANEURISM OF THE SCALP*

WITH THE REPORT OF AN ADVANCED CASE†

By D. C. Elkin, M.D.

of Atlanta, Ga.

FROM THE CLINIC OF DR. HARVEY CUSHING, PETER BENT BRIGHAM HOSPITAL, BOSTON, MASS.

Congenital telangiectases, vascular nevi, or angiomas, which occur so commonly on the face and scalp, may be the starting point of disfiguring aneurismal tumors. When the contributing arteries and the outgoing veins succeed in forming anastomoses through the cavernous bed of the nevus, the lesion becomes nothing more than a diffuse arteriovenous fistula. Such is the probable etiology of most so-called cirsoid aneurisms in which the intermediary incidence of trauma in many cases seems definitely established.

In its mechanical effects, therefore, a cirsoid aneurism resembles an arteriovenous fistula, with the difference that in the latter condition the communication is usually (though not invariably) single, whereas in the true cirsoid the communications are multiple, and take place through the vascular meshes of the tumor.

The condition must have been recognized from the earliest times in view of its striking characteristics, and it would be an interesting study to trace in detail the early records of the lesion;‡ it is not at all improbable that some ancient example may have given rise to the legend of the serpents in the hair of Medusa which Perseus cured by radical though unprofessional measures.

It would appear that the term *anévrysme cirsoïde* (varix-like) was first used by Brescht in 1833, long after William Hunter's description of "aneurism by anastomosis." Though other designations were introduced, as *aneurysma serpentinum* by Cruveilhier, the term "cirsoid," accepted by Verneuil and by A. Robert in 1851, as well as by Ch. Rubin in his excellent description of the erectile tumors three years later, has subsequently come to be the one generally employed in French and English literature.

In the German literature, however, the cases for the most part must be sought under other titles, due largely to the influence of Virchow, who proposed the term *aneurysma racemosum* or *ranken aneurysma*. Moreover, fully cognizant of the fact that a congenital angioma was often the starting point of these lesions, he designated them as *rankenangiom* or *angioma racemosum arteriale*.

---

* Read before the American Surgical Association, April 18, 1924.

† To Dr. Harvey Cushing the writer is indebted for permission to publish this case. Obligations are also due to Mr. K. E. Appel, of the Harvard Medical School, for his aid in reviewing the literature.

‡ For anyone so disposed, the section in Rudolf Virchow's classical treatise on tumors (Die Krankhaften Geschwülste, vol. iii, p. 471 *et seq.*) would make a proper point of departure.

Undoubtedly the cases in the early literature, many of which are cited by Virchow, comprise lesions of various kinds, not all of them in association with primary angiomas; for it is quite probable that arteriovenous fistulæ (more especially those with single or multiple communications involving the vessels of the face and neck) may arise through some faulty vascular development, which may leave one or more arteriovenous communications without the intermediation of a cavernous angioma.¶

From this preamble it may be gathered that there are several varieties of so-called cirsoid aneurism arising in various parts of the body which deserve clinical and pathological differentiation. The present communication, however, will be limited solely to a brief consideration of the anastomosing aneurisms of one type and in one situation: namely, those which affect the scalp and which arise through the intermediation of a preëxisting vascular abnormality of a congenital, angiomatous nature.

In any outspoken example of this condition, the clinical picture is such a startling one that the case is likely to be reported. The extensive literature on the subject shows that these cirsoid aneurisms more often occur on the face and head, whether for the reason that congenital vascular nevi are more common there or because the head is more exposed to the kind of trauma likely to provoke an aneurismal change in the preëxisting lesion is not apparent. Nevertheless, cirsoid aneurisms of the advanced type observed in the patient whose case-history follows are not common. It is the first example of the condition in the *circa* 35,000 admissions to the Brigham Hospital.

P. B. B. H. Surgical No. 17539. John A., an Italian wool-worker, aged twenty-two, entered the medical service of the Brigham Hospital, October 9, 1922 because of a chronic cough, "swellings" on his forehead, and headaches. Though suspected of having incipient pulmonary tuberculosis, he was soon transferred to the surgical service for treatment of his aneurism.

In 1918, while serving in the Italian Army, he had received some minor shrapnel wounds of the scalp, and was subsequently taken prisoner. His wounds which were confined to the occipital region, required no especial care, and though none of them appear to have affected the central region of the aneurism, he states that the top of his head was badly contused at the time.

To this trauma, he naturally ascribes the present condition, for soon afterward, he first noticed the pulsating swelling under the frontal hair margin, which has gradually increased in size. He soon began to be conscious of a roaring sound in his ears and at present this bruit and the startling appearance of the huge vein in his forehead constitute his chief annoyances.

Examination showed a vigorous, alert young Italian who, aside from a chronic bronchitis of doubtful origin, appeared to be in good general physical condition. The outstanding feature of his case lay in the lesion thus described by Doctor Cushing in a

¶ It is quite possible that the recent case reported by F. L. Meleney (Surg., Gynec. and Obst., 1923, vol. xxxvi, p. 547) was of this type. The patient had a small arteriovenous aneurism under the chin. Doctor Meleney has supplied "a complete bibliography of the literature as given in the *Index Medicus* since 1879." This bibliography, however, is confined almost entirely to articles which have appeared under the title of "cirsoid aneurisms" whereas almost an equal number of important articles, chiefly in the German literature and otherwise entitled, do not appear in his list.

FIGS. 1, 2 and 3.—Condition before operation, October 18, 1922.

note dictated shortly before the operation, when the accompanying photographs were taken (Figs. 1, 2 and 3):

"Before this man's head was shaved, there was discernible through the hair a faintly reddish, soft, warm, pulsating tumor measuring 6 by 6 cm., slightly elevated above the surface of the rest of the scalp and situated in the midline about at the coronal suture. Radiating from this tumor in all directions but chiefly laterally and anteriorly are huge, tortuous vessels, the appearance of which naturally suggests the snakes in the head of Medusa. Through the hair, the slightly prominent central area, owing to its discoloration and increased heat, gave the impression of an inflammatory process on the verge of ulceration. After shaving, however, it becomes evident that the central lesion is a reddish nevus, doubtless congenital, of the port-wine-mark variety which overlies a cavernous angioma.

"The enlarged and tortuous vessels which radiate from the lesion are chiefly confined to the anterior half of the scalp. The three main outstanding channels are evidently veins, though they show visible pulsation and have a palpable thrill. The largest of these is a broad vessel measuring nearly 4 cm. at its widest point which passes downward toward the root of the nose. There it bifurcates and extends on each side as far as the alæ. Another large tortuous vein passes off from the right side of the central swelling and extends down toward the anterior part of the ear, where, like the aforementioned vessel, it becomes gradually narrower and finally disappears. There are similar vessels on the left side of the scalp, though less marked than those described.

"These vessels, which are obviously huge pulsating venous channels, are easily distinguished from the arteries, which, however, are likewise unduly prominent and

unusually tortuous, and which can be palpated all the way from their points of appearance on the scalp directly into tumor. This is particularly true of the greatly dilated anterior branch of the right temporal, which can be traced directly into the site of the main central lesion; the same is true of the left temporal as well as the supraorbital arteries. The suboccipital arteries are likewise full and large, and pulsating vessels can be felt over the scalp in the occipital region as well as in the anterior areas where, however, they are particularly pronounced.

"While the patient is sitting up, it is possible to empty the large vessels by pressing upon them near their point of emergence from the main central lesion, proving that they are efferent veins. Moreover, they are visibly pulsating, and there can be no question, therefore, but that arterial circulation through some form of communication is thrown directly into them. The central tumor or swelling is pulsating and apparently contains a large lake of blood. Its tension varies considerably, depending upon the position of the patient, but even when he is sitting up and when all of the arteries possible are compressed, it still remains tense and pulsating.

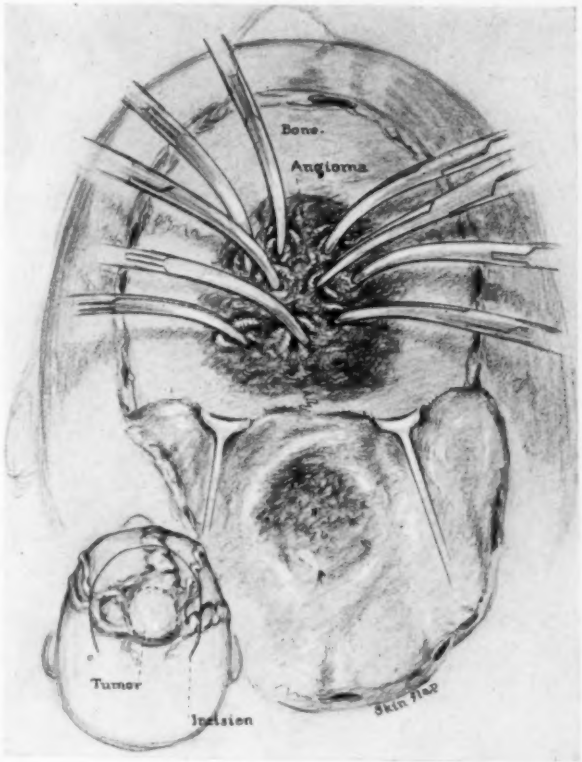


FIG. 4.—Operative sketch indicating procedure which was followed after extensive carotid ligation.

"Pretty much over the entire scalp is heard an astounding bruit, which is audible to the patient and which is precisely like that accompanying an arterial venous aneurism. It is curious, however, that this bruit though heard all over the head is louder at the lower margins of the scalp, particularly in the temporal region and over the glabella than it is directly over the central pulsating tumor itself, where, as a matter of fact, the bruit is scarcely to be heard.

"The X-ray plates show greatly dilated spheno-parietal grooves, and it is quite probable that there is a dilatation of the meningeal vessels corresponding to that of the extracranial vessels. The meningeal artery consequently may participate in the process, and it is possible that the dilated meningeals may communicate with the longitudinal sinus, and thus with the extracranial pulsating mass which has been described. This seems the more probable in view of the fact that when a tourniquet is applied around the head shutting off the extracranial arterial supply there is an enormous increase in the size of the veins of the 'caput' which distend to such a degree that rupture seems impending. This observation makes it appear that a bilateral ligation of the external carotids will be a necessary preliminary step to the operation."

Doctor Cushing's operative note November 4, 1922, is in large part as follows:

"*Ligation of each external carotid artery. Reflection of scalp, disclosing cavernous*

FIGS. 5, 6 and 7.—Condition February 2, 1923, three months after operation following radiotherapy.

angioma. Puckering of angioma by multiple sutures. Replacement and suture of scalp in layers.

"The external carotids were exposed, first on the right side where the vessel was immediately ligated then on the left, where a provisional ligature was thrown around the vessel and a bulldog clip applied so that the circulation might be reëstablished should a slough of the scalp be threatened.

"As shown in the accompanying sketch (Fig. 4), a horseshoe-shaped incision with its base posteriorly was then made around the central pulsating angiomatous mass. By the usual method of finger compression of the scalp, this incision was carried down through the galea and the huge vessels at each side were caught by clamps. Naturally there was no arterial bleeding but the large veins remained as full apparently as before the carotid ligations. On reflecting the flap of the scalp in the subaponeurotic layer, the chief angiomatous tumor was exposed. It seemed to lie more or less within its own pericranial capsule from which the scalp could be dissected away without great difficulty. Fortunately, this central lesion had a great deal of fibrous tissue so that it could be caught by a series of heavy curved clamps (cf. sketch) as the scalp was peeled away from it. Subsequently a multitude of through-and-through silk sutures were taken where the tumor had been gathered up in these clamps: thus the growth was thoroughly 'puckered' in the hope that thrombosis might be encouraged.

"There was no special difficulty in this procedure and the hæmostasis was fairly complete. The scalp was then replaced and closed carefully in layers as usual without any special attention being paid to the individual dilated vascular channels. The bulldog

clip was then removed from the left external carotid, but the arteries in the scalp promptly filled and it was evident that there would be some bleeding. The provisional ligature therefore was tied before closing the wound in the neck."

The circulation in the scalp seemed perfectly good when the usual dressing was applied. However, a very slight superficial slough of the flap margins occurred as the broad scars in the accompanying photographs (Figs. 5, 6 and 7) make evident. The central lesion was subsequently radiated to encourage endothelial destruction and thrombosis.

As is evident from this description, the operation consisted in an attempt to interrupt the vascular channels by an incision encircling the central lesion in the hope of producing thromboses which would cure the fistulous character of the lesion without removing the benign angioma itself. The operation was less formidable than anticipated and it is possible that the cavernous portion of the angioma underlying the galea might have been subsequently removed. This would have meant carrying the dissection down to the skull and removing the tumor together with the pericranium, but, as stated in Doctor Cushing's note, it was assumed that the lesion had vascular connections through the skull with the sinus longitudinalis and was possibly fed by the meningeal vessels. The outcome of the operation showed that this was apparently a mistaken idea: and though the central angioma therefore might have been removed, it is an innocent vascular anomaly in which the possible acquirement of further aneurismal characteristics seems remote. The lesion remains quiescent at the present writing, a year after the operation.

Comment.—As stated in the introductory paragraphs, it is the purpose of this paper merely to put on record another outspoken example of cirsoid aneurism of the scalp with no pretense of covering the full literature of the subject. A large number of these cases have been recorded and many of them have been successfully treated either with amelioration or with cure by a great variety of surgical procedures—by single or bilateral carotid ligations; by multiple circumferential ligations; by attempts to obliterate the lesion with the galvanocautery; by acupressure; by the injection of thrombosing or scar-forming substances; or indeed by extirpation.

Of the many remarkable examples in the literature, possibly the case best known to surgeons was that reported by H. Müller[1] in 1891 from the clinic of Paul Bruns. For his paper was accompanied by a drawing (Fig. 8) which has passed down through several generations of texts and has consequently familiarized many with the appearances of the lesion on post-mortem dissection. As is so common, the patient had a red birth mark at the hair margin of his forehead which greatly increased in size and by his twentieth year had acquired the appearances shown in the dissection. Bruns first ligated the right external carotid and on attempting the same thing on the other side encountered severe bleeding and was compelled to ligate the left common carotid. Hemiplegia followed with a fatality and Ziegler made the studies which have given us this striking illustration of the lesion.

[1] Ein Fall von arteriellem Rankenangiom des Kopfes. Beitr. z. klin. Chir., 1891, vol. viii, pp. 79–91.

To be sure, many other examples occur in the German literature, the surgical aspects of which are chiefly emphasized, some of them representing very formidable conditions. An excellent résumé of the subject up to 1883 was given by Hermann Kümmell.[2] One of the better known cases subsequently reported is that by Paul Clairmont[3] in 1908, the lesion having been attacked in two stages without preliminary carotid ligation. Another outspoken case reported by Max Kepler[4] was operated upon by Heineke in 1910: a huge cavernous cirsoid of the parieto-occipital region, a very desperate and bloody procedure carried out in two stages with a subsequent skin-graft.

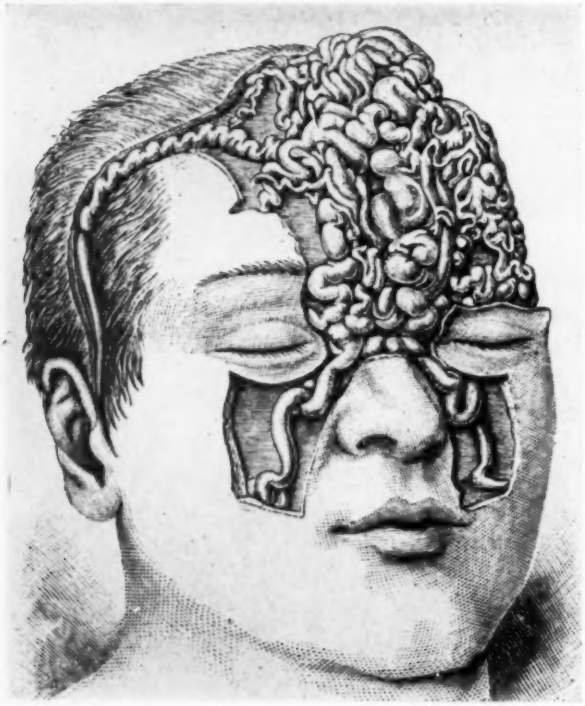


FIG. 8.—Dissection of a plexiform angioma of the forehead. (After H. Müller.)

The French literature likewise contains a good many comparable examples and recently Noordenbos of Amsterdam has reported a case[5] very similar to the one the subject of this report. At the age of twelve the patient had applied for removal of a small vascular tumor on his forehead, but operation was thought inadvisable. Twenty years later, because of its enormous increase in size and its tendency to bleed, intervention was imperative. At operation the external carotid and frontal arteries were ligated on both sides. Catgut sutures were then passed around each afferent vessel and tied over a small roll of gauze. The whole tumor mass was then excised down to the periosteum. Subsequent skin-graft resulted in complete recovery.

The question of an intracranial extension of the lesion which was feared in the case herein reported has arisen in the minds of a good many others and

[2] Zur Behandlung des Angioma arteriale racemosum. Arch. f. klin. Chir., 1883, vol. xxviii, pp. 194–213.

[3] Zur Behandlung des Angioma arteriale racemosum. Arch. f. klin. Chir., 1908, vol. lxxxv, p. 549.

[4] Zur Behandlung des Aneurysma arteriale racemosum. Beitr. z. klin. Chir., 1912, vol. lxxviii, pp. 521–536.

[5] W. Noordenbos and R. de Jong. Aneurysma arteriale racemosum van het Hoofd. Nederlandsch Tijdschrift voor Geneeskunde, 12 Oct., 1918, vol. ii, pp. 1224–1235.

has been thought probable in view of the fact that in a number of patients (*e.g.*, Clairmont's) epilepsy has supervened or else there have been definite evidences of mental deterioration. Indeed, the question was raised as long ago as by Guérin (1870) as to whether an extensive cirsoid of the scalp could come into communication with the intracranial vessels and sinuses. It would appear, however, as was true of our patient, that there was no real ground for this apprehension and seemingly in all other cases in spite of the apparent grooving of the skull by the huge vessels, operation has disclosed no alteration in the skull or evidence of intracranial communication. There nevertheless have been reported a good many examples of aneurismal varices which have originated within the cranial chamber. This, however, is quite another subject.

Very little has been said in the foregoing paragraphs of the cases which have been published from American clinics—all of them, to be sure, very briefly recorded. The older medical literature antedating the great medical indices, if thoroughly perused, would of course be found to contain the records of some of these surprising lesions. Attention may be drawn to two of these early reports at least. One of them was put on record in 1853 by Dr. R. D. Mussey,[6] Professor of Operative Surgery in the Miami Medical College at Cincinnati, Ohio, who described his case under the caption of "Aneurismal Tumors upon the Ear Treated by Ligation of Both Carotids." He speaks of the lesion as being "like an aneurismal varix which had arisen in a congenital nevus."

Another example will be found in a volume published in 1867 by J. Mason Warren,[7] then surgeon to the Massachusetts General Hospital. The case, similar to our own, was described as a so-called cirsoid aneurism of the scalp arising from a congenital nevus starting about at the midline in the roots of the hair "which gave him a very formidable aspect"; and Doctor Warren goes on at length to tell of the many and varied procedures which were carried out by ligatures thrown over needles, followed by the applications of caustic potash repeated between twenty and thirty times to destroy the central lesion.

There are doubtless other similar cases buried in the early American literature. The following list, which may be incomplete, will nevertheless serve to assemble most of the cirsoid aneurisms of the scalp which since 1887 have been put on record in this country.

(1) T. M. Markoe of New York (Phila. Med. News, 1887, vol. l, p. 270). A brief report of a case following trauma, with ligation of both external carotids and probable improvement.

(2) Herman Mynter of Buffalo (Annals of Surgery, 1890, vol. xi, p. 93). A case with ligation of one external carotid followed by circumferential ligation of vessels. Improvement but no late report.

(3) Willy Meyer of New York (N. Y. Med. J., 1892, vol. lvi, p. 214). A very brief report possibly of an arteriovenous fistula rather than a true cirsoid aneurism involv-

[6] Am. J. Med. Sc., 1853, vol. xxvi, p. 333.

[7] Surgical Observations with Cases and Operations. Ticknor and Fields, Boston, 1867. Case cclxii, p. 451.

ing the temporal region. Primary ligation of external carotid with excision of aneurism. In the discussion, cases were mentioned by J. D. Bryant and Kammerer.

(4) WILIAM D. HAMILTON of Columbus, Ohio (N. Y. Med. J., 1894, vol. lx, p. 550). Ligation of one common carotid. Improvement but no late report.

(5) W. S. FORBES of Philadelphia (Phila. Med. News, 1895, vol. xlvi, p. 663). A case almost exactly like our own, with central pulsating tumor following trauma. Treatment, acupressure of entering vessels and subsequent excision of central tumor. Recovery.

(6) WILLIAM B. COLEY of New York (ANNALS OF SURGERY, 1901, vol. xxxiv, p. 414). Unilateral case with involvement of right temporal region; not advanced. Ligation of right external carotid followed by direct attack on tumor. "Nearly one hundred ligatures were applied." Recovery, but result uncertain.

(7) CARL BECK of New York (ANNALS OF SURGERY, 1903, vol. xxxviii, p. 496). "Aggravated case" following trauma. Ligation of temporal and other arteries with extirpation of tumor. Profuse hæmorrhage. Recovery.

(8) RUDOLPH MATAS of New Orleans (New Orleans Med. and Surg. J., 1908–9, vol. lxi, p. 469). Brief report at a society meeting probably a true post-traumatic arteriovenous fistula, not a cirsoid case, though so reported. A bilateral, pulsating exophthalmos was present following fracture of the base of the skull. Ligation of both external carotids. Temporary relief with slowly progressing recurrence.

(9) E. S. JUDD of the Mayo Clinic (St. Paul Med. J., 1916, vol. xviii, p. 48). Perhaps the most extreme example of the condition on record. Ligation of both external carotids followed a week later by bilateral reflection of scalp and dissection of vessels. Probably complete cure.

ANEURISM OF THE INTERNAL MAMMARY ARTERY*

By Fred W. Rankin, M.D.
of Lexington, Ky.

The internal mammary artery, coming off from the subclavian vessel opposite the thyroid axis, pursues an extrapleural course through the thorax to about the junction of the sixth rib with its costal cartilage, where it divides into two trunks; the musculo-phrenic and superior epigastric, the latter of which completes the anastomosis between the upper and lower sections of the body by joining with the ascending branch of the deep epigastric. The anatomical protection of the chest wall renders this vessel less liable to injury than the more superficial vessels of the extremities, and yet occasionally it is divided by a gunshot or stab wound, which in addition almost invariably injures some of the thoracic viscera. Following such an injury a false aneurism or pulsating hæmatoma is rarely seen. Weiting notes two cases of false aneurism of this vessel seen in chest injuries during the recent war. True aneurismal formation, however, is an exceptionally rare occurrence, as a search of the literature reveals only three cases of this nature. In each instance there was a failure of diagnosis; one case being mistaken for an aneurism of the innominate artery or arch of the aorta by one physician, but diagnosed and operated upon for an abscess of the chest wall by another. The other two cases were also operated upon with a mistaken diagnosis and all three terminated fatally. The case which stimulated my interest in this condition came to the Dispensary January 24, 1923, with a pulsating tumor the size of a hickory nut, which presented in the third interspace about one inch from the sternal border. A diagnosis of aneurism of the right internal mammary was made after considerable consultation, and the lesion treated by extirpation of the aneurismal sac which was followed by a prompt and rapid recovery. The case report is as follows:

D. O. Colored, female, age forty-one, married. Chief complaint.—Swelling on right side of chest; some sense of pain around heart.

Family History.—Father dead, tuberculosis, aged fifty. Mother dead, tuberculosis, aged forty-nine. Two brothers living and well; one dead, meningitis. Two sisters living and well; two sisters dead, tuberculosis. Two children living and well. Has had measles, mumps, whooping cough.

Past History.—Patient has been in good health until July, 1923. At sixteen years of age had typhoid fever with complete recovery. At twenty-one years of age she had smallpox. Has dull headaches occasionally which last for about two days. Patient complains that she gets blind when she stoops at times, and notes that headaches precede her menses. There is no alopecia.

Eyes.—Some disturbance of vision, has to wear glasses. Ears: Negative. Nose: Negative. Mouth: Has recently had all of her teeth pulled. Neck: Negative for thyroid enlargement.

* Read before the American Surgical Association, April 18, 1924.

There is no trachial tug. The glands in the posterior triangle of the neck are palpable, but small.

Cardio-respiratory.—Has some cough at times over four or five years; No dyspnœa. Patient thinks she has spit up some blood and had some night sweats, but physical findings and X-ray do not reveal evidences of pulmonary tuberculosis. She has lost thirty pounds in weight since last July. Gastro-intestinal: Negative. Patient has been constipated for some years. Genito-urinary: Negative, except for some frequency of urination.

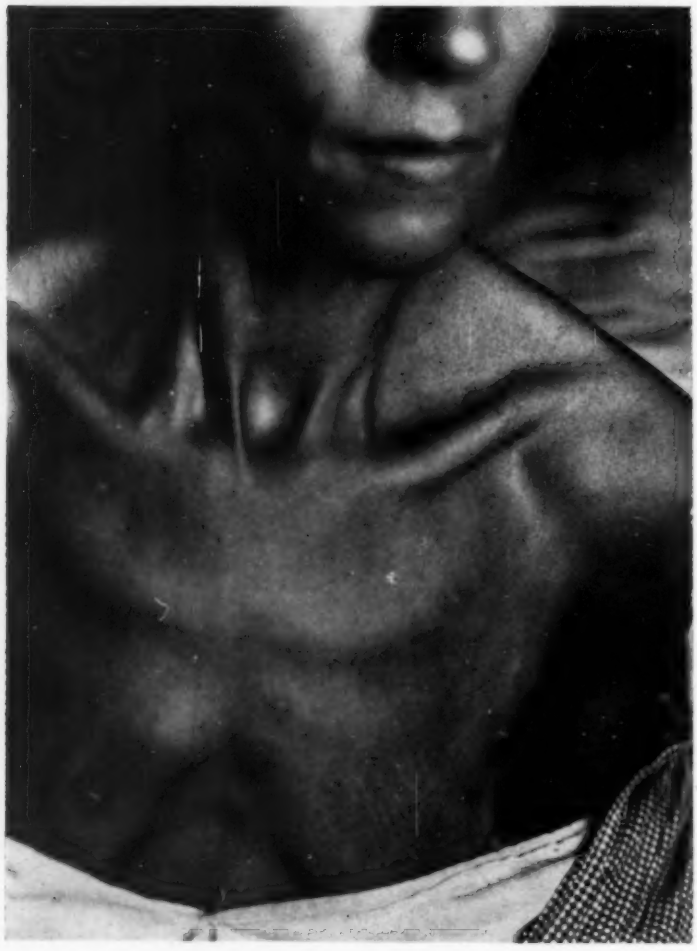


FIG. 1.—Photograph showing internal mammary aneurism projecting in third right interspace.

Venereal.—Patient had a yellowish vaginal discharge a few years ago, but this cleared up under treatment She denies syphilis or other venereal disease.

Menstrual History.—Menses began at sixteen, but prior to that time she had bled vicariously through the nose several times. Up to three years ago her menstruation was regular, occurring once a month, and lasting three or four days. For the past three or four years her menses have been very irregular, occurring twice a month and lasting for seven or eight days. She has some leucorrhœa which is odorless.

Marital History.—Has been married twenty-two years. Has had seven pregnancies; all labors difficult, usually lasting 24 hours or more. She has two healthy children, twenty-one and eighteen years of age respectively, and has had five miscarriages.

Present Illness.—In July of the present year, patient noticed a small pulsating tumor along the right side of the sternum. This tumor began to increase and has progressively and slowly enlarged since. About one month ago she noticed dull pain and tenderness in the entire upper portion of her chest anteriorly. She has had some vertigo occasionally. For the past week has had some dull aching pains in the precordial region. They seem to begin in the axillary line and advance to the sternum, being more marked under the left breast. She has lost thirty pounds in weight in the past seven years; her best weight being 140 pounds; her present weight 110.

Physical Examination.—The examination of the tumor mass shows a pulsating expansile tumor of the right anterior thoracic wall in the third interspace over which a distinct bruit and thrill can be made out. The tumor is about the size of a hickory nut and may be picked up between the fingers, apparently having no attachment to the chest wall. There is no difference in the radial pulse on either side, pulsating in the tumor is synchronous with the radial beat. The blood pressure on each side is 115/80. The skin over the tumor is movable and there is no evidence of inflammation.

Fluoroscopic examination of the chest shows a normal heart and aorta and shows nothing in the area occupied by the tumor.

Wassermann is positive—Four plus.

Urinalysis.—Specific gravity 1020, negative for albumin and sugar. Microscopic examination shows few pus cells and numerous epithelial cells. No casts.

Blood.—Hæmoglobin 85 per cent. White blood cells, 7,500.

Operation.—Under ether anæsthesia an extirpation of the tumor mass was made on January 24, 1923. A longitudinal incision parallel to and about one inch from the outer border of the sternum, and extending from just below the clavicle to a point about one inch above and external to the ensiform, gave ample working exposure. The first step in the incision was to expose the mammary vessels in the first interspace in order to control any of the bleeding that might occur. These vessels, both artery and vein, were found to be dilated the artery being about the size of a normal superior thyroid and the veins correspondingly enlarged. By pressure over the vessels all pulsation in the tumor was stopped. Owing to the rich collateral circulation it was not felt that simple ligation would suffice. I tied the vessels here with catgut and then removed portions of the second, third, fourth, annd fifth ribs for about one inch back of their junction with their costal cartilages and elevated this flap until it was possible to tie the superficial epigastric below the tumor. The corresponding intercostal vessels were ligated as they were approached. By blunt dissection I was able to free the pleura from under the sternum and to get a finger around the entire tumor mass. The costal cartilages were then excised close to the sternum and the aneurismal sac with the portion of the chest to be sacrificed was removed as one specimen. The sac was found to hold about an ounce of fluid and to emerge between the costal cartilage of the third and fourth ribs. There was no bone necrosis at costo-rib junction. The wound was closed without drainage.

FIG. 2.—Gross specimen, anterior view showing the sac on the external chest wall, with the resected ribs and costal cartilage.

The patient made an uninterrupted convalescence and was dismissed from the hospital on the tenth day.

Discussion.—The first case that I have been able to find in the literature was that of

Sickles, who reported in 1847 a case which he had seen eight years previously. This case presented a small tumor of the left chest wall which emerged between the third and fourth ribs and which was about the size of a common marble. By pressing the finger hard upon it he was able to make it disappear into the chest. From its expansile pulsation and the bruit a diagnosis of aneurism was made, but he felt that the aneurismal formation was in the aorta or innominate vessel. The patient subsequently went to another physician and a diagnosis of abscess was made and the tumor was lanced. The ensuing hemorrhage was controlled by pressure but recurred eleven days later with a fatal termination. The autopsy proved the case to be an aneurism of the internal mammary vessel and not of the aorta. The autopsy also revealed that there was some absorption of the fourth rib and a portion of the sternum.

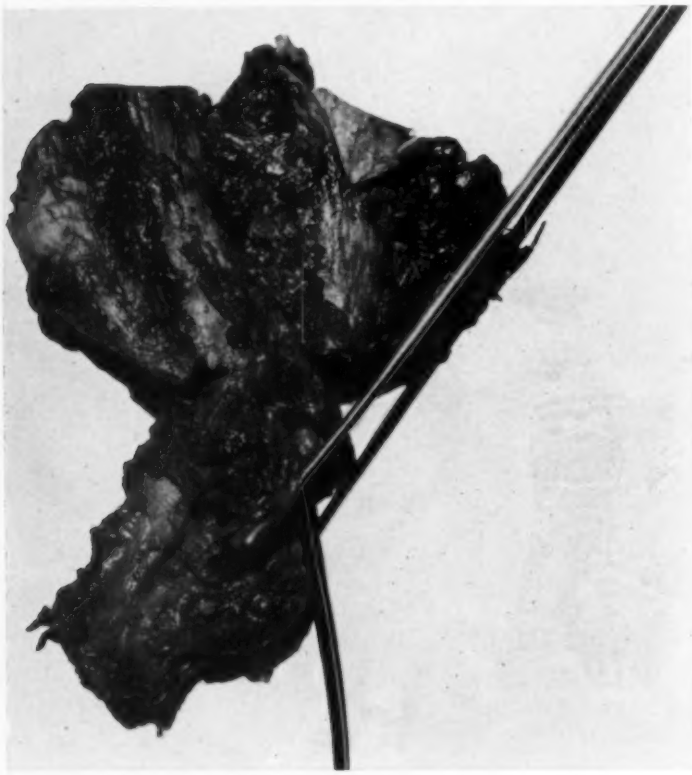


FIG. 3.—Posterior view of same specimen with probes in the mouth of the vessel.

In 1896, Campos Hugueney reported a case of a man fifty-four years of age who presented himself with a tumor of the right chest wall about the size of a walnut, about opposite the sternum in the third interspace. This had been diagnosed a sebacious cyst and incised. The hemorrhage which had occurred was controlled by direct compression and tampons of hyperchloride of iron. Eleven days following this when seen by Hugueney the tumor presented a large ulcerating mass with gangrenous odor, without bruit or expansion; pulsations were synchronous with the radial, and the consistency of the tumor was that of a sac and fluctuant. Recognizing the condition he ligated the internal mammary vessel in the first interspace and abandoned extirpation of the tumor mass. The patient died sixteen days later of a recurrent hemorrhage. Autopsy revealed a true aneurism of the internal mammary vessel.

The case of Reynes published in 1909, was very similar to the two mentioned before. The difficulty of diagnosis is apparent from the notes he makes on the case, and despite considerable consultation he was unable to decide definitely between aneurism of the aorta, a cold abscess, or a pulsating empyema. Finally aneurism was excluded and the tumor mass opened followed by a severe hemorrhage.

Again this was controlled by pressure, which recurred three days later and the patient died.

The aneurismal sac was typical of this type of case the vessel having made a small opening into the tissues and then forming a false aneurism which extended along the ribs communicating with the artery by a narrow neck. On the interior of the thorax was a true aneurismal sac which he aptly describes as an aneurism like a button sewed on a shirt. The artery below the aneurism was obliterated.

It is evident from the observations of the men reporting these cases that a diagnosis is not always apparent, even after careful consideration, and because the röntgenological findings are not conclusive one is frequently confused by several possibilities. Obviously an expansile tumor in any portion of the body over the course of any blood-vessel should be suspected of being an aneurism. In this particular location where the most frequent aneurism is that of the arch of the aorta, the X-ray is of value in determining the size and position of the heart and great vessels of the thorax. In our case the fluoroscopic findings demonstrated that the heart was normal in size and position, and the aorta was normal; the area over the tumor mass showed no difference in density. A pulsating empyema or cold abscess over the ribs themselves would ordinarily be differentiated by the röntgenological findings. The sphygmograph should be a very material aid in deciding the diagnosis by giving the characteristic deformity of the radial pulse in the case of an aortic aneurism; also the anatomical level of the tumor in the third interspace should be sufficient to reject the hypothesis of aortic aneurism. Reynes points out a sign which he believes will enable one to make a diagnosis between an aortic aneurism and an aneurism of the internal mammary. I quote his article: "Aneurism of the internal mammary is of such rarity that one should stop and argue the possibilities of such a thing. If there is aneurism one would be more liable to think of the aorta. However, there are two signs against this diagnosis. First, aortic aneurism; the location of the tumor in the third interspace instead of the second, which indicates at least that the aneurism is very small. Second, the propagation of the systolic bruit is very harsh, especially at the level of the tumor. This bruit follows very nearly the direction of the third and fourth ribs in the axilla and absolutely does not ascend toward the clavicle." He believes that the direction of the bruit toward the axilla can be considered a good differential sign between aortic and internal mammary aneurism.

The diagnosis once established, the question of what surgical treatment to pursue arises. In one of these case reports it is noted that the simple ligation of the internal mammary vessel in the first interspace was followed by a reëstablishment of the collateral circulation, sufficient to cause a secondary hemorrhage which resulted fatally. The rich anastomosis between the intercostals and phrenics below suggests the impossibility of cure without radical extirpation of the sac. The resection of a portion of the chest wall and the costal cartilage following a preliminary ligation of the vessel in the first or second interspace and also below the aneurism, with a total extirpation of the sac, is a feasible procedure which may be carried out without injury to the pleura or danger of unpleasant sequelæ.

REFERENCES

Hugueney, Campos: Anevrysme fusiforme suppure et gangrene de l'artere mammaire droite, dans le troisieme espace intercostal; diagnostic et traitment. Dauphine med. Greenoble, 1896, vol. xx.

Reynes, H.: Un cas d'anevrisme de l'artere mammaire interne. Assn. franc de Clin. Proc. verb. Par., 1909, vol. xxii, pp. 190–194.

Weiting: Zentralbl. Aneurism of Internal Mammary, f. Ch. ii, pp. 47–466, May 15, 1920.

Sickles: St. Louis Med. and Surg. Journ., 1847.

ANEURISM OF THE PALMAR ARCHES*

WITH A REPORT OF AN ANEURISM OF THE DEEP ARCH CURED BY EXCISION

By Henry H. M. Lyle, M.D.
of New York, N.Y.

The rarity of aneurisms of the palmar arches is surprising, when we consider the vascularity and the great number of injuries to the hand. In France, where more attention has been given to this subject, we find several excellent systematic studies. The American, English, Italian and German literature is confined to the reports of a few individual cases; the literature of the war, so rich in vascular injuries, has to date furnished but few examples. We have been able to find sixty-one published cases. To this we are adding a personal case of an aneurism of the deep arch, making a total of sixty-two. Fifty-four involving the superficial arch and eight the deep arch.

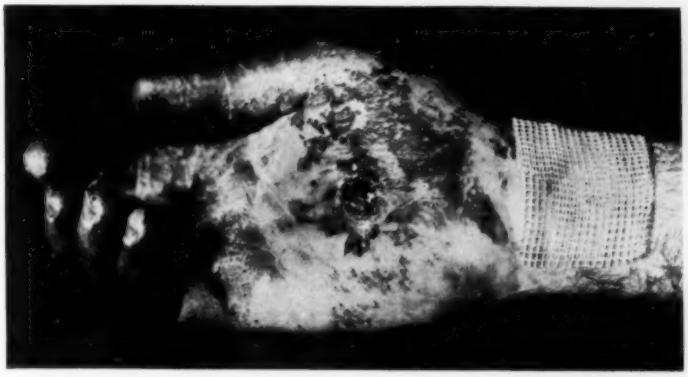


Fig. 1.—Aneurism of the deep palmar arch. Palmar view showing the situation of the wound.

Etiology.—The general predisposing causes, which play such an important rôle in formation of aneurism in general, play but a minor part in the hand. This is due to the high incidence of trauma and the fact that more than half the cases occur in children and in young adults. There are a few reported cases of atheroma of the arteries and two of spontaneous formation. Insufficient data

Fig. 2.—Aneurism of the deep palmar arch. Shows the infiltration of surrounding tissue from the secondary hemorrhages and the aneurism projecting through the wound.

* Read before the American Surgical Association, April 18, 1924.

makes it impossible to determine the relationship of syphilis. The great majority of the aneurisms follow perforating or incised wounds by knives, nails, fragments of glass, etc. Contusions and occupational trauma are responsible for a few cases. It has followed cellulitis of the palm and Roux reports a case following the reduction of a dislocated thumb.

Pathogenesis.—The course of events is as follows: In the traumatic cases, after the external flow of blood has been checked, the escaping blood infiltrates the surrounding tissue, becomes organized and encysted. The false sac may or may not communicate with the blood-vessel, if it does we have a false aneurism (arterial hæmatoma), or the extravasated blood is absorbed and a clot forms, sealing the wound in the blood-vessel wall. The clot organizes and becomes a cicatrix. This scar may give way or dilate under increased arterial strain. In the cases arising from external inflammation there is an actual pathological change produced in the external coat, which spreads to the essential middle coat, and this becoming weakened dilates before the arterial thrust. In the spontaneous cases there is a fatty degeneration of the muscle fibres of the middle coat and a granular degeneration of the elastic fibres.

FIG. 3.—Sac of aneurism, 3.5 x 3 cm.

Symptoms.—The aneurisms vary in size from a pea to an apple, the average being the size of a small hazelnut. The history is of a punctured or incised wound of the palm which bleeds freely and in which the hemorrhage is difficult to check, occasionally there is nothing about the wound to make you suspect that you are dealing with anything other than an ordinary wound. A few cases have been caused by a single contusion, others by a series of repeated contusions received in the course of the patient's occupation. Within five to ten days after the receipt of the injury, the patient notices a small pulsating tumor in the hand. The tumor has appeared as early as twelve hours and as late as five months. The original scar is often visible, the skin may or may not be discolored, sometimes it is ulcerated. The expansile pulsations are accompanied by a soft systolic murmur, a thrill is rare. The expansile pulsations are readily detected in true aneurisms, in the false the presence of clots may modify this symptom. The volume and expansibility of the tumor may be reduced or abolished by pressure on the brachial or by simultaneous pressure on the radial and ulnar arteries. The presence of sensory and motor symptoms can be explained by the relationship of the aneurism to the palmar nerve supply; they vary from slight weakness, tingling, numbness and anæsthesia to excruciating pain and impotency of the hand. Over 80 per cent. of the reported cases have had repeated hemorrhages.

Course.—Abandoned to itself an aneurism may lead to serious consequences, fortunately it is situated in such an exposed region that the patient is forced to seek medical advice and the tumor rarely attains a large size. Early surgical interference yields a prompt cure. Occasionally, pressure

ulceration of the skin is produced. Suppuration and necrosis may result from the original wound or arise from compression and the application of styptics. There are no reported cases of aneurism causing gangrene, but Keen reports a case of gangrene of the hand caused by injecting the sac with Monsell's solution, the gangrene necessitating an amputation at the wrist. Rupture with secondary hemorrhage is a frequent complication. Although few fatal cases have been reported, there are a number of cases in which the repeated hemorrhages have led to grave anæmias. Spontaneous cure is possible as evidenced by Verneuil and Taillaux cases.

Diagnosis.—The diagnosis in general is easy and is often facilitated by the history. Synovial cysts, epidermal cysts, abscesses, lipomas, fibromas and sarcomas, due to transmitted pulsations, have been diagnosed as aneurism. On the other hand, aneurisms have been incised under the impression that they were abscesses, vascular sarcomas, lipomas. Dupuytren operated for a lipoma of the hand and found an aneurism. Verneuil operated for a fibroma and found the supposed fibroma to be an obliterated aneurismal sac.

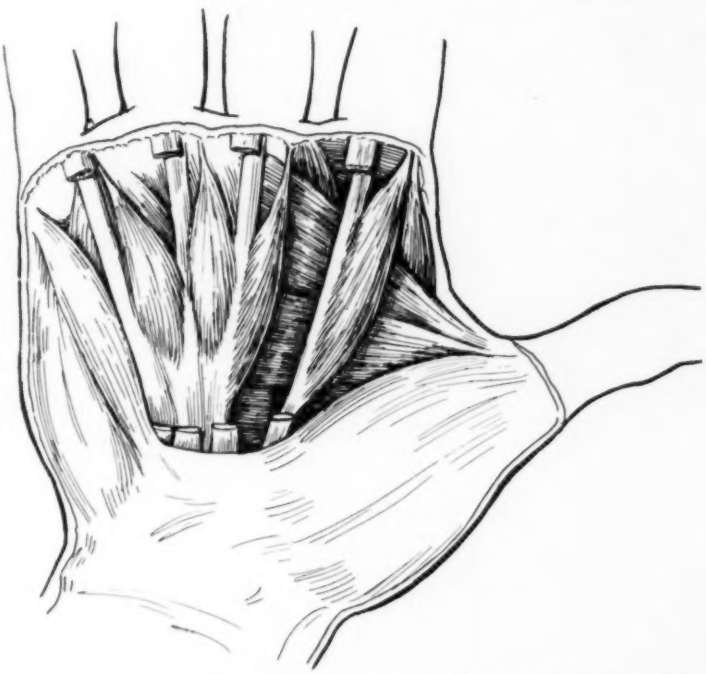


FIG. 4.—Shows insertion of the palmar lumbricales on the deep tendons. Note the arrangement on the index. Delorme takes advantage of this to enter the palm here. Also note the adherent mass of tendons and lumbricales of the little, ring and middle fingers. Direct access to the deep arch is hindered by this mass and in order to get a good exposure a retractor must be insinuated under this mass and the tendons retracted internally.

Treatment.—The ideal treatment for aneurism involving the superficial or deep palmar arch is excision. Incision of the sac after ligation of both ends of the artery has been practiced with success. Schwartz considered excision of an aneurism of the deep arch to be difficult and contented himself with ligation of the radial and compression of the ulna. There are numerous cases on record of failure after the simultaneous ligation of the radial and ulna, and if we stop to consider the various anomalies of the vascular supply of the hand, it is evident that this unfortunate result could occur frequently.

Compression is uncertain and potentially dangerous and should not be used except as a temporary expedient until surgical help can be obtained.

As a prophylactic measure, all narrow penetrating wounds that bleed freely and are in possible relation to the palmar arches should be explored and both ends of the artery secured.

Exposure of the superficial arch is comparatively simple and needs no detailed description. For the exposure of the deep arch the choice of the incision depends on the situation of the aneurism. We have used Delorme's internal palmar incision for the exposure of the deep arch in the hypothenar region and found it most satisfactory. Three of the incisions advocated by Delorme—the mid-palmar, the internal palmar and the dorsal internal incision—are shown in Figs. 5, 6 and 7. The fourth, a dorsal incision we have omitted, as it requires an excision of the upper part of the third metacarpal.

FIG. 5.—Shows mid-palmar incision for exposure of the deep arch. The index tendon with its lumbricale is retracted externally, the mass of flexors with their lumbricales are retracted internally. This is facilitated by flexing the four fingers. The arch is in the upper angle of the wound and is readily traced throughout. The motor branch of the ulna nerve crosses in front or behind the arch at the level of the third metacarpus.

Traumatic Aneurism of the Deep Palmar Arch.—Male, aged twenty-six years, admitted to the service of Doctor Lyle at St. Luke's Hospital, May 8, 1923, referred by Doctor Dugdale. Family and past history immaterial. Present history: Four weeks ago broke a glass bottle against a water faucet and sustained an incised wound of the right palm at the junction of the thenar and hypothenar eminences. The wound bled profusely and sutures were required to check the hemorrhage. Eight days later the wound broke open and bled, ten days later a profuse hemorrhage took place, one week later a mild hemorrhage.

Physical Examination.—Healthy young adult, Wassermann negative. In the right palm, just below the junction of the thenar and hypothenar regions, there is an open wound 2.5 x 2 cm. The edges are everted and the surrounding soft parts are infiltrated with blood. A pulsating swelling about the size of a small hazelnut projects from the

wound. The pulsations are expansile in character and are accompanied by a systolic murmur. Pressure on the radial and the ulna arteries diminishes the swelling but does not obliterate it. The patient complains bitterly of pain in the little and ring fingers, both these fingers are flexed; the thumb is slightly adducted. The repeated hemorrhages have made the patient very apprehensive.

Operation, May 10, 1923.—Excision of aneurismal sac. An open wound being present, a strict Carrel treatment was carried out for two days as preparatory measure. Delorme's internal incision for exposure of the deep arch was used and gave an excellent exposure. The two main arteries with collateral branches were ligated and the sac excised. A wick drain was inserted and the wound closed. The pain ceased immediately. The wound healed in eight days and complete function was restored in four weeks. The patient has remained well. The false sac contained a hollow laminated clot 3.5 x 3 cm. in size and was connected with the deep palmar arch.

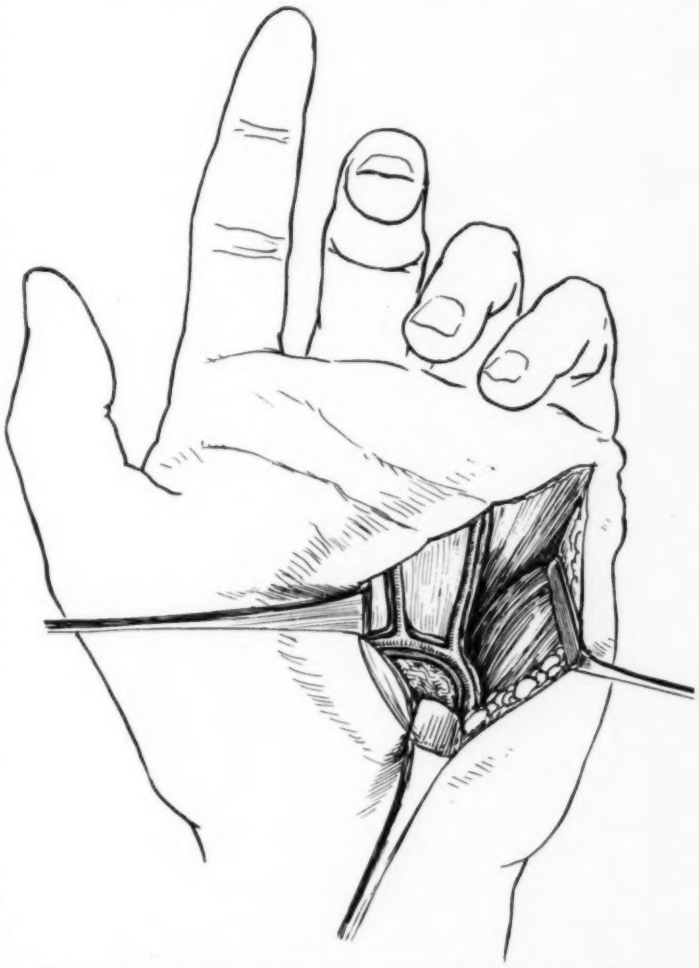


FIG. 6.—Internal palmar incision for exposure of the deep arch. The object is to enter between the flexor tendons and the external border of the hypothenar muscles. The flexor tendons with their tendon sheaths are retracted to the ulnar side. This is facilitated by flexing fourth and fifth fingers. The arch is found in the superior portion of the wound and can be readily exposed to the adductor of the thumb. The ulna nerve to muscles of thumb crosses sometimes in front, sometimes behind, this crossing takes place at the third metacarpus.

ABSTRACTS OF THE REPORTED CASES

We include aneurisms of the superficial and deep palmar arches and their collaterals and also certain cases in which the trauma has been inflicted in the first dorsal interosseous space. We exclude cirsoid aneurisms which are not uncommon. We consider Roberts, Mengers and Zichy-Wolanarski cases as being cirsoids. We have also excluded the few rare cases of arteriovenous aneurisms of the hand.

TABLE I.

Name	Age, sex	Size, cause, location	Time of appearance	Notes	Treatment	Result
Abeille..... 1877	..	Half size of hazelnut, cutting instrument; thenar branch of superficial palmar arch	15 days	Hemorrhages	Compression of radial	Cured.
Baumgarten..... 1920	70 M	Knife, thenar left *deep palmar* arch	4 days	This is the 5th published case of aneurism of deep palmar arch. Diffuse hæmatoma. Severe pain	Ligature of ulna, palmar arch and accessory branches	Cured.
Bellamy	23 M	Glass, hypothenar, superficial palmar arch	14 days	Repeated hemorrhages	Incision and ligation	Cured.
Bulteau..... 1881	8	Size of nut; glass, right hypothenar ulna where it forms superficial palmar arch	1 month		Compression of ulna, failure; electrolysis, failure; ligation of ulna at wrist, recurrence; ligation of radial at wrist and destruction of sac with actual cautery	Cured.
Bouchacourt..... 1855	20 F	Knife	1 day	Hemorrhages	Compression, direct and indirect, failure; perchloride of iron, failure; ligature of radial and ulna	Cured.
Caddy..... 1896	23 F	Hazelnut, glass, right superficial palmar arch	4 days	Pain only present on closing hand—not tender	Ligature of radial and ulna at wrist	Cured.
Chandelux..... 1890	38 M	Large nut, glass, inferior portion of 3rd interosseous space	2 months		Excision	Cured.
Dalche et Menaud..... 1920	.. M	Small, knife, right hypothenar	Few days	Paræsthesia	Intermittent compression	Cured.

Davey..... 1855	20 M	Nut, glass, right superficial palmar arch	4 days	First noticed pain in ring finger	Compression direct and of radial and ulna; had slough from direct pressure	Cured.
Dervaux..... 1907	65 M	Egg, knife, first dorsal interosseous space		At original injury an attempt was made to secure both ends but one retracted, wound was packed	Excision, 3 months later	Cured.
Dittel*..... (See below)						
Dubar..... 1897	26 M	Shoemaker's knife *deep palmar* arch			Successive ligatures of radial, last to deep palmar arch	Cured.
Dupuytren..... 1834	5 M	Fragment of crockery, superficial palmar arch	12 days	Hemorrhages	Actual cautery	Cured.
Duvernoy..... 1870	50 M	Hazelnut, blacksmith *repeated contusions* right thenar superficial palmar arch	Gradual	Pain in hand	Direct compression, then compression of radial and ulna	Cured.
Griffiths..... 1897	23 F	Spontaneous, 1¼ x ½ in. hypothenar, branch to superficial palmar		Considered it a case of local *endarteritis*	Excision	Cured.
Guattani..... 1772	45 M	Coachman, *chronic irritation* of reins and whip, hypothenar superficial palmar arch	Gradual	Mistaken for abscess	Incised and packed with gauze	Cured.
Guerineau..... 1847	.. M	Fragment of porcelain superficial palmar arch	8 days	Hemorrhages	Indirect compression, ligature of ulna, galvano-puncture, recurrence in 29 days, galvano-puncture	Cured.
Guernnonpre and Besson..... 1902	26 M	Small nut, knife, superficial palmar arch			Excision 1½ months after accident	Cured.

TABLE I.—*Continued.*

Name	Age sex	Size, cause, location	Time of appearance	Notes	Treatment	Result
Happel..... 1881	..	Acorn, catfish fin, left thenar, superficial palmar arch	8 days		Direct compression, failure; rupture of sac, sac opened, clots removed, ligature on radial in such a way as to include sac	Cured.
Haywood..... 1871	..	Glass, left superficial palmar arch			Incised sac, ligature above and below, ligatures cut through due to soft tissue. Ligature of ulna	Cured.
Herrgott..... 1860	..	Traumatic, superficial palmar arch			Compression, failure; double ligature	Cured.
Jahresberecht..... 1861	7	Nut, glass, left hypothenar superficial palmar		Grave anæmia from repeated hemorrhages	Compression, failure; excision cure	Cured.
Jones, S..... 1867	29 F	Large, hypothenar	4 weeks	Pain with impairment of movement of fingers	Compression of radial and ulna	Cured.
Jones, S..... 1877	15 M	Hazelnut, glass, left palm	5 days	Recurrent hemorrhages *brachial*	Compression failure; *ligature of brachial*	Cured.
Keen..... 1882	Child	Sharp pebble, superficial palmar arch		*Amputation of hand*	Compression and injection of Monsell solution, this was followed by gangrene of hand which necessitated amputation at the wrist	

Keen and Gross 1893	38 F	*Recurrent aneurism* 12 years after, right hypothenar			Ligature of radial and ulna by Keen, original operation by Gross 12 years before, Gross performing three operations before securing a cure. Operation on aneurism, ligature of ulna, ligature of brachial, original injury was bruise of hand husking cord—5 years of age, operated by local physician	Cured.
Kendirdzy and Reclus..	35 M	Cherry pit, below right hypothenar	3 months	Paræsthesia	Excision	
Kirwan..... 1921	5 F	Pigeon's egg, glass, right palm, superficial palmar arch	5 days	Thrill felt. Ring and little fingers flexed in palm	Excision	
Lamas..... 1922	31 M	Butcher knife, hypothenar, superficial palmar arch			Extirpation of sac. Operation was performed by Nin-Y-Silva	Cured.
Lannelongue..... 1877	..	*Deep palmar* arch			Compression of radial and ulna for 24 hours	Cured.
Lannelongue..... 1877	..	Superficial palmar arch		Threatened rupture	Incision of sac with ligature	Cured.
Letenneur..... 1875	19 M	Glass, mid-palmar superficial palmar	1 month	Repeated hemorrhages severe pain	Compression, failure; compression, rupture of sac	Cured.
Lyle..... 1923	26 M	Hazelnut, glass, palm, *deep palmar*	4 weeks	Pain and hemorrhage	Excision	Cured.
Marias..... 1920	14 M	Nail, right palm superficial palmar arch		Mistaken for abscess repeated hemorrhage	Ligature of radio-palmar, ulna and collateral mistaken for abscess and incised, repeated hemorrhages, true nature discovered three days later. Grave anæmia, required intravenous solution	Cured.

TABLE I.—*Continued.*

Name	Age sex	Size, cause, location	Time of appearance	Notes	Treatment	Result
Marques and Marques.. 1920	.. M	Small egg, agricultural laborer, repeated contusions, right thenar *deep palmar* arch		*Mistaken for solid tumor.* Painful, right thumb and index interferred with	Incised by mistake—ligature and extirpation of sac	Cured.
Marjolin..... 1859	12 F	Glass, superficial palmar arch	6 days		Intermittent compression	Cured.
Mauclaire..... 1908	31 M	Cherry pit, glass, right palm, superficial palmar arch	24 days		Excision of sac	Cured.
Mazade..... 1866	43 M	Knife, left palm, superficial palmar arch	9 days	*Abscess* and repeated hemorrhages	Compression, chloride of zinc, cauterization with *compression of brachial artery*	Cured.
Maydl..... 1896	33 M	Size of walnut, fork, right palm, *deep palmar arch*		Rapid growth *rendering hand useless*	Incised and packed. Ligature of ulna where it becomes the deep arch	Cured.
Maydl.....	46 M	Size of walnut, knife, first interosseous space	3 weeks	Maydl's aneurism of rami dorsalis art radialis dextra	Excision 3 weeks after accident	
Molliere..... 1885	19	File, right palm, superficial palmar arch	Several days	At first small, rapidly increased in size reaching maximum in 8th day	Profuse hemorrhage. Ligature superficial palmar arch, was not known if both ends were tied. *Recurrence*, excised, cured	Cured.
Morestin..... 1905	43 M	Small nut, *spontaneous*, left hypothenar and palm, supercifial palmar arch		Spontaneous, patient recalls no contusion or wound	Excision 6 weeks after onset, it was necessary to sacrifice a small cutaneous nerve which was adherent to sac	Cured.

Nélaton..... 1862	M	Traumatic, superficial palmar arch			Chemical cauterization—chloride of zinc	Cured.
Newbolt..... 1908	32 M	One inch in diameter, chisel, left palm, superficial palmar arch	2 months	Pain and numbness in index and ring fingers	Applied for treatment 2 months after wound. Incised sac wall and ligated superficialis volæ, ulna and communication to deep arch	Cured.
Parker*..... (See below)						
Pozzi..... 1881	55 M	Pigeon's egg, glass, left hypothenar, superficial palmar arch	8 days	*Atheroma of arteries* severe pain	Direct and indirect compression, failure. Incision of sac and ligature of both ends of superficial arch and the digital artery entering sac	Cured.
Rastouil.....	26 M	3 x 2 cm., *contusion* superficial palmar arch	8 days	No wound, loss of power in hand. Sensory disturbances marked	Excision	Cured.
Regnault..... 1912	37 M	Pea, contusion, left superficial palmar arch	3 weeks	Naval gunner, contusions striking breech block to loosen it. No lues	Excision of sac	Cured.
Richet..... 1882	M	Revolver ball, superficial palmar arch			Rupture during treatment, compression	Cured.
Robertson..... 1897	M	Contusions, fight hypothenar superficia palmar arch	5 months	Pain and numbness. Was an engineer. Blow on hand against engine lever	Compression, failure; ulna ligated at wrist	Cured.
Robinson.....	35 M	Hickory nut, struck-hand to loosen tap *deep palmar arch*	1 month	Possible lues, 15 years before	Excision	Cured.

TABLE I.—*Continued.*

Name	Age sex	Size, cause, location	Time of appearance	Notice	Treatment	Result
Roux..... 1837	25 M	Apple, sustained it reducing his own *dislocation of thumb* right thenar	1 day		This patient fell dislocated thumb and pulled in place himself, next morning large swelling, incised, hemorrhage. Compression of radial and ulna failure, later actual cautery. *Two months later* came to Roux who tied radial, proposed to tie ulna hemorrhages, patient died before ulna could be tied	Died.
Salmon..... 1890	25 M	Large nut, knife, 1st interosseous space			Excision	Cured.
Schwartz..... 1890	M	Knife, *deep palmar* arch			Ligature of radial and ulna 1 month after accident	Cured.
Taillaux et Millet..... 1891	10 M	Cherry pit, glass, superficial palmar arch	8 days	*Spontaneous obliteration*	Direct compression with *compression of brachial, failure;* large secondary hemorrhage, shock, incision of sac it was found that a spontaneous cure had taken place	Cured.
Tuffier.....	30 M	Size of franc, glass, hypothenar, terminal branch of ulna	8 days	Pain movements restricted	Excision	
Verstroete..... 1902	24 M	Hypothenar			Incision	Cured.

Verneuil 1859	32 M	Glass, palm, superficial palmar arch	Several days		Compression of radial and ulna, failure, digital *compression of brachial* with forced extension of hand	Cured.
Verneuil..... 1866	M	Shoemaker's knife, superficial palmar arch	5 days		Compression and application of perchloride of iron, failure. Incision and ligature	Cured.
Verneuil..... 1874	..	Shlegmon of palm, superficial palmar arch		*Mistaken for abscess*	Indirect compression, failure injection of perchloride of iron. After multiple incisions for abscess of palm, secondary hemorrhages developed and later an aneurism appeared. Verneuil states that the arch was not injured by the incisions	
West..... 1856	17 F	Glass, left, between thumb and forfinger	10 days	Hemorrhages	Compression of radial and ulna. *Tourniquet to brachial* cured by creosote	
Zynn, Vander H..... 1839	..	Wound palm left hand, spurious aneurism			Ligature of radial and ulna 1½ inch above wrist, recurrence 15 days later, second ligature of ulna 1 inch above first	
*Dittel..... 1863	15 M	Pea, knife, left palm, superficial arch	4 weeks	Sensory disturbances in ulna region after ligation	Cured by compression of brachial artery. This took 64 days and is a typical record of the pain and discomfort this method entails.	
*Parker..... 1852	19 F	Marble, glass, left superficial arch	10 days	Secondary hemorrhage fingers flexed in palm		

CONCLUSIONS

1. Aneurisms of the superficial palmar arch are not common, aneurisms of the deep palmar are extremely rare, only eight having been recorded.

2. The majority of the cases are caused by trauma with direct injury to the vessel wall, an insignificant number result from local or general pathological disease of the vessel wall, a small group are caused by chronic irritation and repeated contusions. Two cases have been reported as being spontaneous.

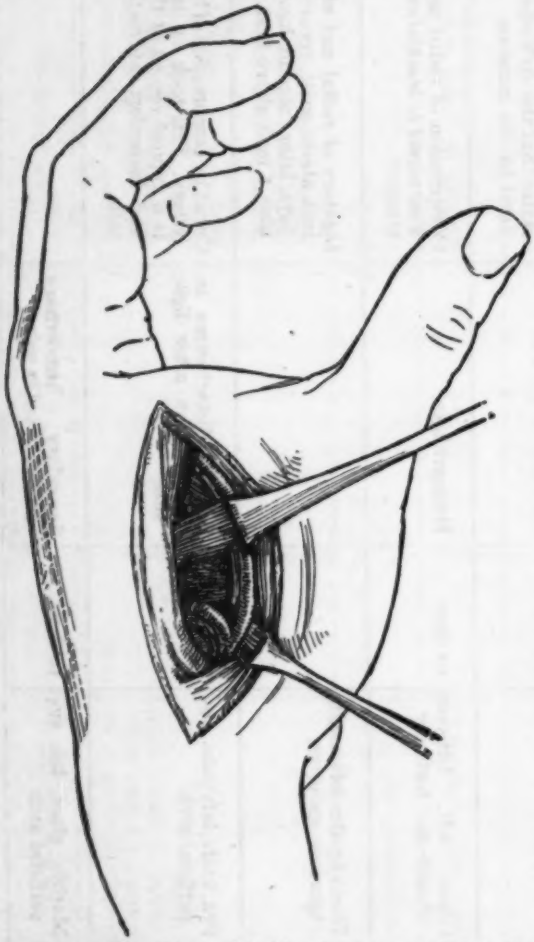


FIG. 7.—Dorsal internal incision for exposure of the radial origin of the deep palmar arch, this also gives access to the deep collateral of the index and thumb.

3. The best treatment is an early excision of the aneurism; this applies to both the superficial and deep arches.

4. As a prophylactic measure, all narrow penetrating wounds which bleed freely and are in possible relation to the palmar arches, should be explored and both ends of the artery secured.

5. Although these aneurisms do not occur frequently, we should remember their possibility and in the prognosis of a trauma to the palm reserve a place for them.

BIBLIOGRAPHY

Abeille: Bull. Gén. de Thér., 1877, p. 508.

Baumgartenn: See Thèse Coffin.

Bellamy: Traumatic Aneurism of the Palm; Operation of Laying Open Sac; Recovery. Lancet, 1883, vol. ii, p. 725.

Bouchacourt: Gaz. Med. de Lyon, 1855, p. 336.

Bulteau: Anévrysmes traumatiques de l'Arcade palmaire superficielle Union Médicale et Scientifique du Nord-Est, Reims, 1881, p. 183.

Caddy: A Case of Circumscribed Traumatic Aneurism of the Palm. Lancet, London, 1896, vol. ii, p. 603.

Chandelux: See Mollin. Thèse de Lyon, 1890.

Coffin: Les Anevrysmes de la Main, Paris, Thèse, 1920.

Comte: Etude sur quelques cas d'anévrismes traités par la méthode de Purmann. Thèse de Lyon, 1885.

Dalche-Menaud: Jour. des Praticiens, 1920, vol. xxxiv, p. 709.

Davey: Case of Traumatic Aneurism of the Superficial Palmar Arch. Med. Times and Gazette, London, 1855, N. S., vol. xi, p. 210.
Delbet: Sur le traitment des anévrysmes Artériels (ixe Congrès français de Chirurgie, 1895, p. 744.
Delbet et Mocquot: Nouveau traité de Chirurgie. le Dentu et Delbet, vol. xi, Artières, p. 206 (Anévrysmes de la Main).
Delorme: Sur les Anévrysmes de la main. Bull. et Mem. de la Soc. de Chir. de Paris, No. 19, 21 Mai, 1912, vol. xxxvii, p. 678.
Dèpres: Soc. de Chir. Paris, 1877, p. 601.
Dervaux: Arch. Provinciale de Chir., 1907.
Dittel: Traumatisches Aneurysma in lenken oberflachlechen Hohlahndbogen. Wiener Medizinal—Halle, 1863, vol. v, No. 8, p. 77.
Dubar: See Toffart. Thèse de Lille, 1896–1897, No. 27.
Duplay et Reclus: Traité de Chirurgie, Paris.
Dupuytren: See Martin Thèse de Paris, 1870, or Aussandon Thèse Paris, 1843, p. 70.
Duval: Apropos de 18 anévrysmes traumatiques opéres. Bull. et Mem. Soc. de Chir., No. 7, 23 pev., 1915.
Duvernoy: Thèse de Paris, 1870.
Griffiths: British Med. Jour., London, 1897, vol. ii, p. 646.
Guattani: Des externis Anevrismatibus. Rome, 1762. (Quoted by Thiebaud.)
Guerineau: Gaz. Hôpitaux, 1847.
Guernnonprez et Besson: Jour. de Sci. Med. de Lille, 1902, vol. i, pp. 169–193.
Happel: An Aneurism of the Superficial Palmar Arch Caused by a Catfish Fin. Med. and Surg. Reporter, Philadelphia, 1881, vol. xlv, p. 556.
Haywood: Operation for Traumatic Aneurism of the Superficial Palmar Arch. Trans. Med. Soc. North Carolina, 1871, vol. xviii, p. 28.
Hergott: Anévrisme de l'arcade palmaire compression (insuccés): Ligature double (succés). Gaz. Med. de Strasb., 1860, vol. xx, p. 108.
Jahresbrich-Kinderh: Leipzig, 1881, vol. xvii, p. 302.
Jones: Lancet, 1867, vol. i, p. 116.
Jones: British Med. Jour., 1877, vol. ii, p. 562.
Keen, W. W.: Annals Ant. and Surg., 1882.
Keen, W. W.: International Clinics, Philadelphia, 1893, 3rd series, vol. ii, p. 194.
Kendirdjy: Reclus, see Thèse Thiebaud.
Kirwan: British Med. Jour., Dec. 31, 1921, p. 1113.
Kopfstein: Weiner klin. Rundschau, 1896, p. 237.
Lannalongue: Soc. de Chir., 1877, p. 606.
Lautaret, E.: Des Anévrysmes traumatiques de l'arcade palmaire superficielle et de leur traitement. Thèse de Paris, 1907–08, No. 296.
Letenneur: See Thèse O'Neil.
Mauclaire: See Thèse Lautaret. Symptoms, Diagnostic et traitement des anévrysmes artériels des membres. (Progrès médical, 1911, No. 36, 9 Septembre.) Discussion, Chirurgie Bull. et Mem. de la Soc. de Chir., No. 13, 2 Avril, 1912.
Marias: See Thèse Coffin.
Marjolin: Bull. de Soc. de Chir. de Paris, 1859, p. 319.
Marques-Marques: Aneurisma da mao Annals Paulistas di Medicine et Cirurgia, 1920, vol. xi, No. 7, p. 159.
Martin, G.: Plaies artérielles de la main. Thèse de Paris, 1870.
Maydl: See Kopfstein Wiener Klin. Rundschau, 1896, vol. x, p. 237.
Mazade: Observation d'anévrisme de l'arcade palmaire superficielle Cauterisation; Guérison. France med., Paris, 1866, vol. iii, p. 4.
Menger, R.: Aneurism of the Palmar Arch of Left Hand. Daniel's, Texas, M. J. Austin, 1890–1, vol. vi, p. 297.
Mollière: See Thèse Comte.

Mollin: Contribution a l'étude des anévrysmes artériels de la main et leur traitement. Thèse Lyon, 1890.

Monod: Anévrysmes de la paume de la main. Bull. et mem. Soc. de Chir., Paris, 1912, vol. xxxviii, pp. 464–68 (Discussion).

Monod et Vanverts: Chirurgie des arteres Rapport au xxii. Congrès français de Chir., 1909, p. 51. Du Traitement des Anévrysmes artériels. Documents et Remarques Revue de Chirurgie, No. 5, 10 Mai, 1910, p. 784, No. 6, 10 Juin, 1910, p. 1098. Du Traitement des Hematomes artériels et artério-veineux. Documents et Remarques. Revue de Chirurgie, 1911, vol. xliii, p. 46, et 196.

Morestin: Anévrysmes de l'arcade palmarie superficielle. Bull. et mem. soc. anat., Paris, 1905, vol. lxxv, pp. 556–560.

Nélaton: Gaz. de Hôp. Paris, 1862, p. 193.

Newbolt: Palmar Aneurism. Med. Press. and Circ., London, 1908, p. 96.

Parker: Lancet, 1856, vol. ii, p. 679.

Prat: Chirurgie vasculaire. Foreign Corresponding Member. Bull. et mem. de Chir., Paris, 1922, No. 48, p. 1282.

Pozzi, S.: Anéurysme de l'arcade palmaire superficielle. Bull. et mem. Soc. de Chir. de Paris, 1881, pp. 232–237.

Rastouil: Anévrysme de l'arcade palmaire superficielle consecutif a un traumatisme sans plaie. Rapport de M. Robineau, Bull. et mem. Soc. Chir., vol. xxxix, No. 1, 14 Janvier, 1913, p. 15.

Regnault, J., et Bourrut-Lacouture: Anévrysme de l'arcade palmaire superficielle suite de contusion, Rapport de M. Potherat. Bull. et Mem. Soc. Chir., vol. xxxviii, No. 11, 19 Mars, 1912, p. 420. Discussion No. 13, 2 Avril, 1912, p. 464.

Richet: Gaz. des Hôp., Paris, 1882.

Roberts: Boston Med. and Surg. Jour., 1882, p. 516.

Robertson: The British Med. Jour., 1897, p. 1637.

Robinson: Aneurism of the Superficial Palmar Arch. Jour. Amer. Med. Assoc., 1912, vol. lvii, p. 32.

Roux: Gaz. Med. de Paris, 1837, p. 524.

Salmon, A.: Anévrysmes de la main. Thèse, Paris, 1890.

Schwartz, E.: See Salmon Observation, No. 14.

Silva, Dr. Nin-Y.: Reported by Prat from Prof. Lamas Clinic (See Prat).

Taillaux et Millet: See Thèse de Salmon, Paris, 1891.

Thiébald: Contribution a la étude des anévrysmes de l'arcade palmaire superficielle. Thèse de Paris, 1914, No. 159.

Toffart: Thèse de Lille, 1896–1897, No. 27.

Tuffier: Discussion. Bull. et Mem. Soc. Chir. de Paris, vol. xxxviii, No. 13, 2 Avril, 1912, p. 464.

Vanlaer: Des anévrysmes de l'arcade palmaire superficielle. Thèse de Lille, 1901–1902, No. 89.

Verneuil: Anévrisme traumatique de l'artére cubitale à la paume de la main. Compression digitale. Soc. de Chir., Paris, 16 Fev., 1859, vol. ix, p. 319. Gazette hébdomadaire, 1866, p. 471. Observation d. anévrismes Bull. de la Soc. de Chir., vol. iii, 1874.

Verstroeste: See Vanlaer. Thèse de Lille, 1902.

West: Lancet, 1856.

Zichy-Woinarski: Australian Med. Jour., 1884, vol. vi, pp. 196–200.

Zynn, Vander H.: Wound of Palm of Left Hand, Spurious Aneurism. Boerhave Tijchchrift Geavenhag, 1839, vol. i, p. 220.

THE INCIDENCE OF CONGENITAL CLEFTS OF THE LIP AND PALATE*

By John Staige Davis, M.D.

of Baltimore, Md.

From the Surgical Department of the Johns Hopkins University and Hospital

I have frequently been asked how often congenital clefts of the lip and palate occur, and have never been able to give a definite answer. The object of this paper is to determine as definitely as may be the incidence of these clefts. It is based on a study of the cases of congenital clefts of the lip and palate which have occurred up to March 1, 1924, in 24,158 deliveries in the Obstetrical Service of the Johns Hopkins Hospital † and in 3927 deliveries in the Hospital for the Women of Maryland.

A review of the literature shows that Fröebelius, in 1865, published a report based on the number of congenital clefts of the lip and palate found among 180,000 children admitted to the St. Petersburg Foundling Hospital between the years 1833 and 1863.

He estimated that these clefts occurred once in 2400 births and his figures have been generally accepted and constantly quoted. For a number of reasons, to be mentioned later, it is obvious that congenital clefts would occur more frequently in 180,000 total births than in the same number of admissions to any institution. Nothing further has been written on the subject.

One cannot determine the incidence of congenital clefts of the lip and palate from the records of any surgical clinic, as many children with these malformations die before they are presented for operation or admission; many of the simpler cases are operated on at home; and a considerable number are never brought for operation.

The number of these cases applying for operation at the larger surgical clinics varies according to the increase in the population of the district from which that clinic draws; according to the reputation of that particular clinic for success with these cases; according to the knowledge of the public at large that much can be done for the relief of these deformities and the consequent willingness of parents to bring children for operation.

It is possible that the frequency of occurrence of congenital clefts of the lip and palate may vary in different parts of the world. This may even be true in different sections of our own country and also there may be a difference in rural and urban communities. This seems to be indicated by the statistics compiled from the draft records of the defects found in the first 2,500,000

* Read before the American Surgical Association, April 19, 1924.

† I wish to thank Dr. J. Whitridge Williams, who very kindly placed at my disposal the records of the Obstetrical Department of the Johns Hopkins Hospital.

men examined for the United States Army in the world war, which show that in Vermont, at one extreme, the ratio of the occurrence of congenital clefts of the lip and palate per 1000 men examined was 1.55, while at the other end of the list stood Arkansas with a ratio of .16 per 1000. These statistics also showed that the incidence was highest per 1000 in the agricultural sections of the northern states.

As these figures are based entirely on the examination of men of military age no definite conclusion can be drawn from them as to the frequency of occurrence of congenital clefts, as those in females, those dying in infancy of malnutrition or following operation, and those operated on successfully are not included.

As far as I have been able to ascertain no mention is made of congenital clefts of the lip and palate in the official birth records now in use in this country or abroad, and in consequence accurate information cannot be obtained for the whole country or even for individual states, until uniform birth statistics are required which will cover this point.

It has been said that the frequency of occurrence of the types of congenital clefts may change and this was noted by Bruns, who quotes Langenbeck as saying in 1828: "In the past eight years the simple harelip has become a rare occurrence and the cleft palate a frequent phenomenon." He also quotes Walter in 1834, who says "double and complicated harelips occur at present more frequently than simple harelip, and much more frequently than thirty years ago." Bruns in 1873 confirms this idea from his own statistics. These observations may or may not be of value as the differences might have been caused by the fact that only the more difficult cases were brought into these particular surgical clinics.

In this study our interest is solely in the number of congenital clefts of the lip and palate which came to delivery, and not in those which are found so frequently in pathological embryos aborted in the early months of gestation.

For convenience and for purposes of comparison, I have separated the cases studied into three series.

SERIES A. The negro cases from the obstetrical service of the Johns Hopkins Hospital.

SERIES B. The white cases from the same clinic.

SERIES C. The white cases from the obstetrical service of the Hospital for the Women of Maryland.

SERIES A. NEGRO CASES FROM THE OBSTETRICAL DEPARTMENT, JOHNS HOPKINS HOSPITAL

Number of congenital clefts of the lip and palate in 12,520 deliveries—7. *Nationality of mothers*—United States, 7. *Ages of mothers.* Youngest, 21; oldest, 36; average, 26. *Health of mothers.* Good, 6; excessive vomiting (early months), 1. *Mentality of mothers.* Usual ward type. *Ages, health and mentality of fathers.* No routine note. *Social status.* Ordinary ward type.

Primipara, 2; *multipara,* 5. Both of the primipara were 21 years old. Of the multipara, one child was the third of a 24-year-old mother; one was the fourth of a 26-year-old mother; one was the fourth of a 30-year-old mother; one was the fifth of a 30-year-old mother and one was the tenth of a 36-year-old mother.

Sex of child. Male, 3; female 4. *Year of birth*—1899, 1; 1902, 1; 1906, 1; 1907, 1; 1915, 1; 1920, 1; 1922, 1. *Legitimate,* 6; *illegitimate,* 1. *Presentation*—L.O.A., 3; R.O.P., 3; R.O.A., 1.

Delivery. At term, 5. Spontaneous, 4; version, 1. Premature, 2. Both spontaneous. Seven and one-half months macerated fœtus, 1; 8½ months child, died immediately after birth. *Weight at birth.* Heaviest, 3317 gms.; lightest, 2268 gms.; average, 2648 gms. *Length at birth.* Longest, 53 cm.; shortest, 42 cm.; average, 47.7 cm.

Malformation.‡ *Alveolar cleft lip,* 2 cases. In one female child, there was a right unilateral complete cleft of lip with notching of the alveolar process on right side. Palate intact. In one male child, there was a bilateral complete cleft of the lip with notching of the alveolar process on both sides. Palate intact.

Alveolar cleft lip and palate, 4 cases. In two males and two females, there were bilateral complete clefts of the lip, alveolar process and palate.

Alveolar cleft palate, 1 case. In a female child, there was a unilateral (side not given) complete cleft of the alveolar process and palate. Lip intact.

Associated anomalies, 3 cases.

In one girl, there was clubbing of feet and hands with polydactylism. (Died fortieth day.) In one girl, there was malformation of the mandible and enlarged thymus. In one boy, there was rudimentary hand and forearm and ankylosed elbow. (7½ months' fœtus; still-born.)

Mortality, 5 cases. One 7½ months macerated male fœtus, placenta luetic; one 8½ months female child, died after a few gasps, typically luetic, placenta negative; one female child still-born at term, placenta luetic; one male child died third day (mother had condylomata and the placenta was luetic); one female child died fortieth day of inanition. Three of these were typically syphilitic in appearance, although the Wassermann reaction was negative for the mother in 1; for the mother and father in 1; and for the mother, father and cord in 1.

SERIES B. WHITE CASES FROM THE OBSTETRICAL DEPARTMENT, JOHNS HOPKINS HOSPITAL

Number of congenital clefts of the lip and palate in 11,638 deliveries—13. *Nationality of mothers*—Bohemian, 1; Irish, 1; Roumania, 1; Russian, 2; United States, 8. *Ages of mothers.* Youngest, 17; oldest, 38; average, 25½. *Health of mothers.* Good, 10; excessive vomiting (in early months), 1; health poor, 1; tuberculosis of lungs, 1. *Mentality of mothers.* Ordinary ward type, 12; feeble-minded, 1. *Ages, health and mentality of fathers.* No routine note. *Social status.* That of ordinary ward patient.

Primipara, 7; *multipara,* 6. The ages of the primipara were 17, 19, 20, 22, 24, 26 and 33 years and 4 of the 7 children were illegitimate. Of the multipara, one child was the second of a 20-year-old mother; one was the second of a 23-year-old mother; one was

‡ In this paper the classification of Davis and Ritchie will be used. Group 1. *Prealveolar* (process) *cleft.* (Lip cleft; alveolar process normal.)
Cleft of the palate may be associated with this group.
Group II. *Postalveolar* (process) *cleft.* (Palate cleft; alveolar process normal.)
Cleft of the lip may be associated with this group.
Group III. *Alveolar* (process) *cleft.* (Cleft follows incisor sutures.)
Clefts of the lip and palate are usually associated in this group.

the second of a 25-year-old mother; one was the third of a 35-year-old mother; one was the third of a 38-year-old mother and one was the sixth of a 30-year-old mother. One of these children was illegitimate.

Sex of child. Male, 10; female, 3. *Year of birth,* 1905, 2; 1907, 1; 1909, 1; 1911, 2; 1915, 2; 1916, 1; 1919, 2; 1921, 2.

Legitimate, 8; *illegitimate,* 5. *Presentation*—L.O.A., 7; L.O.T., 1; R.O.A., 4; R.O.P., 1. *Delivery* At term, 12 Spontaneous, 9; mid-forceps, 2; low forceps, 1. Premature, 1. Spontaneous, 8 months. *Weight at birth.* Heaviest, 3954 gms.; lightest, 2085 gms.; average, 3250 gms. *Length at birth.* Longest, 52 cm.; shortest, 46 cm.; average, 49 cm.

Malformations. Prealveolar cleft, 5 cases. In one of these, a girl, the cleft was complete; in four boys, the clefts were incomplete. All were unilateral. The cleft was on the left side in two boys and one girl; the side was not given in two boys.

Alveolar cleft lip, 1 case. In a boy, there was a bilateral complete cleft of the lip with notching of the alveolar process on the left side.

Alveolar cleft lip and palate, 4 cases. In one, a girl, there was a bilateral complete cleft of the lip, alveolar process and palate. In three, all boys, there were unilateral clefts, one right and two left, of the lip, alveolar process and palate. Two of these were complete and one was incomplete.

Prealveolar and postalveolar cleft, 1 case. In this case, a boy, there was a unilateral left incomplete cleft of the lip with complete cleft of the hard and soft palate, the alveolar process being intact.

Postalveolar cleft, 2 cases. In both cases, a boy and a girl, there were complete clefts of the soft palate, the alveolar process and lip being intact.

Associated anomalies, 2 cases. In one boy, there was a stricture of the ureter and hydronephrosis. (Died 5th day.) In one girl, there were bilateral club feet and polydactylism of the right hand. (Died 1st day.)

Mortality, 6 cases. One girl died on the 1st day, one hour after birth. (Bilateral club feet, polydactylism.) One boy died on the 5th day. (Stricture of the ureter and hydronephrosis.) One boy died on the 21st day. (Bronchopneumonia, post-operative.) One boy died on the 24th day. (Bronchopneumonia and inanition). One boy died on the 35th day. (Inanition.) One girl died when 8 months old. Cause not given. In none of these cases was syphilis suspected or demonstrated.

SERIES C. WHITE CASES FROM THE OBSTETRICAL DEPARTMENT OF THE HOSPITAL FOR THE WOMEN OF MARYLAND

Number of congenital clefts of lip and palate in 3927 deliveries, 4. *Nationality of mothers*—United States, 4. *Ages of mothers.* Youngest, 27; oldest, 28; average, 27½ years. *Health of mothers.* Good, 3; nasal sinusitis, off and on during pregnancy, 1. *Mentality of mothers.* High grade. *Social status of mothers.* High grade. *Ages of fathers.* Youngest, 26; oldest, 55; average, 37¾. In one instance, the father was 28 years older than the mother and in another 15 years older. In one instance, the mother was 1 year older than the father and in one instance, the ages of the parents were equal. *Health of fathers.* Good, 4. *Social and mental status of fathers.* High grade, 4.

Primipara, 4. *Sex of child.* Male, 4. *Year of birth.* 1918, 2; 1919, 1; 1922, 1. *Legitimate,* 4. *Presentation.* L.O.A., 4. *Delivery.* At term, 4. Spontaneous, 3; low forceps, 1. *Weight at birth.* Highest, 3615 gms.; lowest, 3153 gms.; average, 3322 gms. *Length at birth.* Not noted.

Malformations. Alveolar cleft lip and palate, 3 cases. In two boys, there were bilateral complete clefts of lip, alveolar process and palate. In one boy, there was a unilateral left, complete cleft of lip, alveolar process and palate.

Postalveolar cleft, 1 case. In a boy, there was a cleft of the posterior third of hard palate and all of soft palate, the lip and alveolar process being intact.

Associated anomalies, 1. In this case, a boy, there was unilateral club foot on the right side (cleft on left side), and slightly bifid nose.

Mortality, 0. All of these cases were operated on and lived. The youngest being now 2 years old. Syphilis was not suspected or demonstrated in any of these cases.

GENERAL SUMMARY OF THE ENTIRE SERIES

Number of congenital clefts of the lip and palate in 28,085 deliveries—24. *Nationality of mothers*—19 were natives of the United States; 1 was a Bohemian; 1 was Irish; 1 was Roumanian and 2 were Russians. Color. White, 17; black, 7.

Ages of the mothers. Second decade, 2; 17 and 19 years. Third decade, 15; one each, 22, 23, 25 and 28 years; two each, 20, 21, 24 and 26 years; three each, 27 years. Fourth decade, 7; one each, 33, 35, 36 and 38 years; three each, 30 years. The average age of the mothers of Series A was 26 years; in Series B was 25½ years; in Series C was 27½ years, with a general average of 26⅓ years.

Health of the mothers. In the negro series, it is probable from the appearance of the child and placenta that four mothers were syphilitic, although all tests were negative. All of these reported themselves in excellent health. One of the white mothers complained of "poor health" at the time of conception and another of tuberculosis of the lungs. Two mothers, one white and one colored, reported excessive vomiting during the first 2½ months of pregnancy. Otherwise, the health of the mothers was excellent.

Mentality of mothers. High grade, 4; ward type, 19; feeble-minded, 1. *Health of fathers.* This was noted in only 3 cases in the Johns Hopkins Hospital series and all of these were in good health. In the 4 cases in Series C, the health of the fathers was excellent. *Mentality of fathers.* High grade, 4; ward type in those mentioned, 3. *Primipara,* 13; *multipara,* 11. *Sex of child.* White, male, 14; female, 3. Negro, male, 3; female, 4. Total, male, 17; female, 7.

Years of birth. 1899, 1 case; 1902, 1 case; 1905, 2 cases; 1906, 1 case; 1907, 2 cases; 1909, 1 case; 1911, 2 cases; 1915, 3 cases; 1916, 1 case; 1918, 2 cases; 1919, 3 cases; 1920, 1 case; 1921, 2 cases; 1922, 2 cases. *Legitimate.* White, 12; negro, 6. Total, 18. *Illegitimate.* white, 5; negro, 1. Total, 6.

Presentation. L.O.A., 14; L.O.T., 1; R.O.A., 4; R.O.P., 4; not given, 1.

Delivery. In 21, delivery was at term; in 3, the birth was premature. The labor was spontaneous in 19 cases; 13 white and 6 colored. Mid-forceps and low forceps were used in 2 cases each, all being whites. There was 1 version in a negro woman with a contracted pelvis. Of the 3 premature births, one was white, 8 months; and two were colored, 7½ and 8½ months. *Weight at birth.* White, highest, 3954 gms.; lowest, 2085 gms.; average, 3263 gms. Colored, highest, 3317 gms.; lowest, 2268 gms.; average, 2648 gms. *Length at birth.* White, longest, 52 cm.; shortest, 46 cm.; average, 49 cm. Colored, longest, 53 cm.; shortest, 42 cm.; average, 47.7 cm.

Malformations.—Prealveolar cleft (cleft of the lip alone). The lip alone was cleft in 5 cases, all being in white children and all unilateral. One was complete (the cleft extending into the nostril) and 4 were incomplete. In 3, 2 males and 1 female, the clefts were on the left side, and in 2 male children, the side was not noted.

Alveolar cleft lip (cleft of the lip with notching of the alveolar process), 3 cases. In one negro girl, the cleft was unilateral complete with cleft and notch on the right side. In one negro boy, the cleft was bilateral complete with notching of both sides. In one white boy, the cleft was bilateral complete with notching of the alveolar process on the left side.

Alveolar cleft lip and palate (cleft of the lip with cleft of the alveolar process, hard

and soft palate), 11 cases. Seven were bilateral complete clefts, 4 of these being colored, 2 boys and 2 girls; 3 white, 1 girl and 2 boys. Three were unilateral complete clefts, all being in white male children, one being right and two left. One was a left unilateral incomplete cleft of the lip with complete cleft of the alveolar process and palate in a white boy.

Prealveolar and postalveolar cleft (cleft of the lip and palate, the alveolar process being intact), 1 case. In a white boy, there was an incomplete left-sided cleft of the lip with complete cleft of the hard and soft palate.

Alveolar cleft palate (cleft of the alveolar process and palate, the lip being intact), 1 case. There was cleft of the alveolar process and palate in one negro girl. The side was not given.

Postalveolar cleft (cleft of the palate alone), 3 cases. There was cleft of the posterior third of the hard and soft palate in 1 boy, and of the soft palate in two cases, one boy and 1 girl, all being white.

Associated anomalies. In 6 cases, there were other congenital anomalies, associated with lip and palate clefts. Three of these were in white children. One, a boy, had a stricture of the ureter and hydronephrosis and died on the 24th day; one girl with bilateral club feet and polydachtylism of the right hand, died on the first day; one boy, who had a slightly bifid nose and a club foot on the right side (the cleft being on the left side) still survives. Three were in negro children; one of these, a girl, had clubbing of the feet and hands and polydactylism of feet and hands, died on the 40th day; one girl had enlarged thymus and malformation of the mandible, was still-born at term; one boy, a 7½ months macerated fœtus, had a rudimentary hand and forearm and ankylosed elbow.

Mortality. Within 8 months, 11 died out of the 24 cases. One was a macerated 7½ months negro male fœtus; one was a 8½ months negro girl, who died after a few gasps; one negro girl was still-born at term; one white girl died the first day, one hour after birth; one negro boy died the third day, luetic; one white boy died the fifth day, stricture of the ureter and hydronephrosis; one white boy died the twenty-first day, post-operative bronchopneumonia; one white boy died the twenty-fourth day, inanition and bronchopneumonia; one white boy died the thirty-fifth day, inanition; one negro girl died the forty-second day, inanition; one white girl died when 8 months old, cause not given.

COMMENTS

Five out of twenty-four of the mothers were of foreign birth, but this appears to have no significance. There is nothing noteworthy in the ages of the mothers. Bad health of the mother or father, or both, at time of conception and of the mother during the early months of pregnancy has been considered a possible cause for these malformations, as has also been excessive vomiting during the first two and one-half months of pregnancy, and these facts should be borne in mind. There was excessive vomiting during the first and second months in three instances. One mother had pulmonary tuberculosis at time of conception. Another had "poor health" at time of conception.

It has been claimed that syphilis is the definite factor in causing these malformations, and there was probably syphilis in 4 cases, all of these being in Series A. From this number (4 out of 7 cases) of apparently syphilitic children with congenital clefts of the lip and palate, it might be inferred that syphilis played a definite part in the etiology, at least in the negro group.

We must bear in mind, however, that the majority of syphilitic children, both black and white, are born without this malformation. In Series B and C, no case of syphilis is recorded and this seems to refute the idea, at any rate for the white group.

Low-grade mentality of the parents has also been suggested as a possible cause of congenital clefts of the lip and palate. In the cases studied, only one mother is listed as feeble-minded. The mentality of the others was sufficiently normal to excite no comment.

The difference in the ages of the parents has also been considered a possible etiological factor. In one instance, the mother (feeble minded) was twenty years old, and the father (the girl's own father) was fifty-three years old, a difference of thirty-three years. In another instance, the father was fifty-five and the mother twenty-seven; and in another there was fifteen years difference. These were the most marked instances of difference in the ages of the parents in this series.

Maternal impressions were not recorded on the majority of the histories, and although interesting they are of no particular importance as etiological factors.

Although no notes were found in the family histories of the occurrence of similar congenital clefts, heredity undoubtedly plays an important part in the occurrence of these clefts of the lip and palate. The percentage given by different authors varies between 15 per cent. and 20 per cent. In my own cases, I have noted about 19 per cent. with a family history of congenital clefts.

It has been said that these congenital malformations occur more frequently in illegitimate than in legitimate children. In this series, 18, or 75 per cent., were legitimate and 6, or 25 per cent., were illegitimate; all of these were in Series A and B. Inasmuch as one-fourth of the children were illegitimate, notice must be taken of this fact; but I question the importance of illegitimacy as an etiological factor.

Doubt has been expressed by those who seldom see negro patients as to whether congenital clefts of the lip and palate ever occur in this race. From case reports elsewhere and from the number reported in Series A, we can conclude that the occurrence is not infrequent, but that it is not so common as in the white race.

The question of social status and environment is of considerable interest. The majority of the patients in the Johns Hopkins Hospital Series A and B, were of the public ward and out-patient service type. Those from the Hospital for the Women of Maryland, Series C, were of the private ward class. It has been generally accepted that a greater proportionate number of these malformations occur among the children of individuals of the lower and more ignorant classes, whose nutrition and hygienic surroundings are poor, than among those whose environment is all that could be desired and whose mental attainments are of higher degree.

In 12,520 deliveries of negro women in Series A, 7 congenital clefts of the lip and palate were found, or 1 in 1788+. In 11,638 deliveries of white women in Series B, 13 congenital clefts were found, or 1 in 895+. In 3927 deliveries of white women in Series C, 4 congenital clefts were found, or 1 in 981+. Taking the white series together, we find in 15,565 deliveries, 17 clefts, or 1 in 915+; combining all the series, in 28,085 deliveries, there were 24 clefts, or 1 in 1170.

In other words, in series A, where all conditions were most unfavorable, congenital clefts of the lip and palate occurred comparatively much less often than in series B and C. It may be that these clefts occur less frequently in the negro race than in the white, irrespective of environment, etc., but if this consideration is left out, these figures seem to upset the theory as to social status and environment. A comparison of series B and C show that clefts occur in the white public ward cases (1-895+) more frequently than in the private ward cases (1–981+), but the comparative difference is not great when we take into consideration the vast contrast between the environment and social status of these groups.

We find that 13 out of 24, or 54+ per cent., of the entire series were first children. Eleven white mothers were primipara as compared with 2 negro mothers, which shows that the proportion of congenital malformations of the lip and palate were greater in white primipara than in negro primipara. On the other hand, there was a greater proportion of negro multipara, 5 out of 7, as compared with the white multipara, 6 out of 17.

Haug in 1904 collected from the literature 2352 cases of congenital clefts operated on in various surgical clinics and found that 64.3 per cent. were males and 35.7 per cent. were females. In this series there were 7 females, or 29.17 per cent., and 17 males, or 70.83 per cent. In other words, these clefts occur much more frequently in male than in female children.

The first delivery in the out-patient Obstetrical Service of the Johns Hopkins Hospital was on January 1, 1895, and the first congenital cleft occurring on this service was on July 14, 1899, or four and one-half years later. The first delivery in the Obstetrical Ward of the Johns Hopkins Hospital was on August 17, 1896, and the first congenital cleft on this service occurred on July 22, 1902, or about six years later.

Nothing abnormal was noted during pregnancy, in the type of presentation and in the course of labor in this series. Delivery was at term in 87 per cent. of the cases.

The average weight of a full term normal white infant at birth is 3250 gms. The average weight in this series is 3263 gms., which is approximately normal. The average weight of a full term normal negro infant at birth is 3104.8 gms. The average weight of this series is 2648 gms., which is considerably less than normal.

The average length of a full term white normal infant at birth is 49.64 cm.

The average length of this series of infants is 49 cm., which is normal. The average length of a full term normal negro infant is 48.75 cm. The average length of this series is 47.7 cm., which is slightly shorter than normal.

From these figures, it can be said that the average weight and length of a full term white child with a congenital cleft of the lip and palate in this series of cases is equal to that of the normal white child at birth. In only one of the negro cases did the birth weight reach normal for this race. This may be accounted for by the state of health of the mothers, 4 out of 7 being probably syphilitic. Less favorable hygienic surroundings and possible malnutrition during pregnancy may also have had some effect on the weight of the children of the negro series.

The lip was cleft in 20 cases, 83+ per cent. of the series. In 5 of these, 25 per cent., the lip alone was cleft. In 15, or 75 per cent., there were in addition clefts of either the alveolar process or palate or both. In other words, clefts of the lip complicated with clefts of the bony structure were found three times as often as simple clefts.

The palate alone was cleft in 3 cases, 12.5 per cent., and the alveolar process and palate in one case, 4+ per cent. of the series. Therefore, clefts of the palate alone occurred less often (12.5 per cent.) than simple lip clefts (20.8 per cent.).

A comparison of the most severe types of clefts shows the following: *Alveolar cleft lip and palate* (cleft of the lip, alveolar process and palate) occurred 4 times in 7 cases in Series A; 4 times in 13 cases in Series B and 3 times in 4 cases in Series C. Of these in Series A, all were bilateral complete, in Series B, one was bilateral and in Series C, 2 were bilateral.

It is noteworthy that in Series A, 57 per cent. were in the bilateral group; in Series C, 50 per cent. were in this group, while in Series B, only 7+ per cent. were bilateral. Thus we find that the negro series showed the highest percentage of the bilateral type of cleft with the private ward, Series C, a close second.

Of the unilateral type in this same group, there were 3 cases in Series B and one in Series C, and if we consider these in connection with the bilateral group, we find in Series A, 5 per cent.; Series B, 30+ per cent.; and in Series C, 75 per cent. In other words, in the series with the highest mentality and most favorable surroundings, the comparative number of severe cases was greatest.

In the twenty cases with cleft of the lip, 2, or 10 per cent., were on the right side; 8, or 40 per cent., were on the left; 8, or 40 per cent., were bilateral and in 2, or 10 per cent., the side was not stated. This would make the occurrence of the clefts on the left side four times as frequent as on the right, and in this series the bilateral clefts occurred in the same proportion, which seems unusually large.

The record of 11 deaths out of 24 cases (11 out of 20, or 55 per cent., in

Series A and B) is interesting, as it shows the mortality to be extremely high, even in the hospital where every facility is at hand for proper handling and care. It stands to reason that outside where facilities are frequently lacking, the mortality must be at least as high and is very probably higher. Syphilis, inanition and bronchopneumonia have been the principal causes of death.

A follow-up of the cases in Series B showed that one each was living 15, 13, 3 and 2½ years after leaving the hospital. In Series C, one each was living 6, 5½, 5 and 2 years after discharge. In Series A, none could be located.

It is interesting to compare the frequency of occurrence of congenital clefts of the lip and palate with other congenital malformations and this was possible in Series A and B.

In 24,158 deliveries in the Johns Hopkins Obstetrical Service, the following congenital defects, in addition to the 20 cases of cleft of the lip and palate, were found: Amnion adhesions, glaucoma, muscle defect, absence of œsophagus, situs transversus and diaphragmatic hernia, one each; intrauterine amputation, cystic kidney, anencephalus, two each, or one in 12,079; skeleton defect, teratoma, three each, or one in 8052+; anus imperforate, hemicephalus, tracheo-œsophageal fistula, four each, or one in 6039+; hernia, except umbilical, defects of intestines, six each, or one in 4026+; defects of digits, defects of the external ear, eight each, or 1 in 3019+; webbed fingers, nine, or one in 2684; hypospadias, nævus, eleven each, or one in 2196; acrania, 14, or one in 1725+; tongue tie, 19, or one in 1271+; hydrocephalus, 20, or one in 1207+; spina bifida, 21 or one in 1150, and club foot, 26, or one in 929+; multiple digits, 134, or one in 180+; umbilical hernia, 390, or one in 61+.

The above makes a total of 713, *i.e.*, one congenital defect (other than cleft lip and palate) in every 33+ children delivered. This seems to be an extremely high percentage of defects, although the greater number were not of serious nature. We find that only spina bifida, club foot, multiple digits and umbilical hernia occurred more frequently than congenital clefts of the lip and palate.

CONCLUSIONS

The incidence of congenital clefts of the lip and palate cannot be determined from a study of the admissions of these cases to surgical clinics or to institutions. Likewise, accurate data cannot be obtained on this point from the examination of male adults of draft age.

Definite conclusions cannot be drawn as to the relative importance of the various possible etiological factors, although in the negro series syphilis must be considered. Nothing unusual was noted during the course of pregnancy, labor and delivery, and the presentations were normal.

In 28,085 deliveries, 24 clefts of the lip and palate were found.

Congenital clefts of the lip and palate occur in the negro race (in this series, 7 in 12,520 deliveries), but with less frequency than in the white (in this series 17 in 15,565 deliveries).

Environment and social status are apparently of little importance, as in the negro series, where conditions were most unfavorable, clefts occurred much less frequently (1–1788+) than in either white series. However, in the public ward white series, clefts occurred more frequently (1–895+) than in the private ward series (1–981+). The incidence in all the series together was 1 in 1170+; in the two white series 1 in 915. These figures show a frequency of occurrence much greater than that estimated by Fröebelius.

More than half the clefts were in first children.

The percentage of males was 70+, of females 29+ per cent.

Clefts of the lip on the left side and bilateral clefts were found equally often, each occurring four times as often as right-sided clefts.

The lip was cleft in 83+ per cent. of the cases. Of these in 25 per cent., the lip alone was cleft; in 75 per cent. there were, in addition, clefts of either the alveolar process or palate or both. The palate alone was cleft in 12.5 per cent. of the cases and the alveolar process and palate in 4+ per cent.

In Series C, with the highest mentality and with the most favorable surroundings, the relative number of alveolar cleft lips and palates, the most severe type of cleft, was greater than in the other white series, 75 per cent. as against 30+ per cent. This group of clefts occurred in 57 per cent. of the negro series.

The average weight and length of a full-term white child with congenital cleft of the lip and palate is equal to that of the normal child at birth. The average weight of the negro child with congenital cleft of the lip and palate is considerably less than that of the normal negro child at birth and the average length is slightly less.

Associated anomalies occurred in 25 per cent. of the cases. This is a much larger percentage than we ordinarily find in cases admitted for operation. The mortality during the first few months is extremely high, 11, or 45+ per cent., of the entire series. Syphilis, inanition and bronchopneumonia were the principal causes of death, although in addition five of these cases had associated anomalies.

Children, with congenital clefts, who live past the first year, apparently have a reasonably good chance of surviving.

The occurrence of congenital defects, other than those of the lip and palate, in the Johns Hopkins cases is astonishingly high, one in every 33+ deliveries.

I realize that the number of cases studied in this series is too small to allow accurate conclusions to be drawn. However, certain information has been gained which is of considerable interest and value, and which sheds light on the incidence of congenital clefts of the lip and palate, at least in this locality.

BIBLIOGRAPHY

v. Bruns: Handb. d. prakt. Chir., vol. ii, p. 1, Tübingen, 1873.

Davis, John Staige, and Ritchie, Harry P.: Classification of Congenital Clefts of the Lip and Palate, J. A. M. A., Oct. 14, 1922, vol. lxxix, p. 1323.

Dissman, C.: Cases of Harelip Treated at the Clinic in Bonn during the Past Twenty Years, Theses (C. George), 1884.

Frazer, J. E.: The Occurrence of a Cleft Palate, The Practitioner, London, Nov. 17, 1917, vol. xcix, p. 401.

Fröebelius: St. Petersburg Med. Zeitschr., vol. ix, 1865, p. 173.

Haug, G.: Statistical Data on Harelip Based on 555 Cases at v. Bruns' Surgical Clinic at Tübingen, Beitrg. z. Klin. Chir., vol. xliv, No. 2, pp. 254–277, 1904.

Williams, J. Whitridge: Obstetrics, 5th edition, 1923, p. 162.

ŒSOPHAGOTOMY FOR FOREIGN BODIES IN THE ŒSOPHAGUS*

By Philemon E. Truesdale, M.D.
of Fall River, Mass.

Foreign bodies arrested in the œsophagus command attention because their presence is a source of great danger and their removal becomes immediately a very vital problem. Children often fall victims to this accident because they are in the habit of placing a great variety of articles in their mouths. In adults, about 62 per cent. of the cases are due to chicken bones, fish bones, or poorly fitted artificial teeth.

In regard to the situation at which foreign bodies may become lodged, it has been observed that small pointed bodies which easily penetrate the mucous membrane may become fixed at any point in the œsophagus. Very large bodies usually cannot pass the isthmus and remain fast in the pharynx. The larger variety of foreign body which has passed through the pharynx most frequently lodges at those places where, under normal conditions, the œsophagus is constricted, 1st, just behind the crycoid cartilage, 2nd, the middle constriction which is about opposite the bifurcation of the trachea and on a level with the 7th cervical vertebra, and 3rd, the inferior constriction, where the œsophagus passes through the diaphragm. Foreign bodies which reach the inferior constriction and stop there, usually have been forced down by attempts to get them into the stomach with bougies. The spontaneous descent of larger foreign bodies to the lowest constriction is rare. The majority of foreign bodies remain lodged in the cervical portion of the œsophagus. Kronlein explains this by the fact that here the œsophagus is wedged in between the vertebral column, the larynx, the thyroid cartilage and in the aperture of the thorax.

Among the earliest writers upon this subject, the French appear to have contributed the most valuable monographs. Although Goursald (cited by Guattani, *loc. cit.*) was the first to perform œsophagotomy for this condition in 1738, Guattani (Memoirs de l'Academie de Chirurgie, Tome 1, 1819) was the earliest systematic writer on the technic of œsophagotomy. Sir William Ferguson in his surgery published a valuable treatise in which he cautioned his readers that however simple the operation seemed on the dead subject, it was attended with much labor on the living and the surgeon could escape its hazards only by the most painstaking dissection. Among American surgeons the contributions of Dr. David Cheever, of Boston, in a monogram published in 1868 were notable. He made an exhaustive review of the literature on the subject and reported three cases operated upon by himslf.

He emphasized the fact that attempts at extraction by mouth were capable of infinite mischief; that owing to the structure and connections of the œsophagus its walls are especially prone to perforations and such accidents

* Read before the American Surgical Association, April 18, 1924.

have occurred from the use of the probang. The œsophagus is united to the prevertebral muscles only by the loose connective tissue. On this account it is readily pushed before the probe and injured. In this respect it is analogous to the membranous portion of the urethra and should be handled with meticulous care. Deaths from efforts to remove foreign bodies in the œsophagus through the mouth are more common than is generally supposed.

Ingalls (Ingalls, E. F., Amer. Jour. Surg., Jan., 1912, p. 42), writing in 1912, said: "A few years ago the removal of foreign bodies in the œsophagus by means of the œsophagoscope was considered devoid of danger, but we know that fatalities may occur and we have reason to believe that in general there may be a large percentage of mortality."

Among the modern authorities the work of Chevalier Jackson (bronchoscopy and œsophagoscopy), of Philadelphia, stands out preëminently. He has perfected the operative technic through the œsophagoscope to a very high degree and thus placed a sharp limit on the cases needing the open operation. His mortality of 2 per cent. or less represents the most skilful work among trained operators. Jackson feels that the mortality in the hands of those without adequate training and experience must be many times greater than this. He regards the œsophagoscope in the hands of rough, careless and unskilled physicians as a dangerous and often fatal instrument. Moreover there are risks associated with the use of the œsophagoscope which he describes as "Complications and Dangers." Asphyxia from pressure of the foreign body or the foreign body plus the œsophagoscope is a possibility; faulty position of the patient, with faulty direction of the œsophagoscope may cause alarming symptoms from pressure upon the trachea, especially when the patient is under general anæsthesia. Prompt introduction of a bronchoscope with oxygen and amyl nitrite insufflation and artificial respiration may be necessary to save life. Whenever cocain is used the danger of poisoning cannot be ignored. Perforation of the œsophagus with the œsophagoscope, while rare in skilful hands, it is a recognized liability especially when the œsophageal wall is weakened by ulceration or trauma. In the presence of these pathological changes there exists a danger of making a false passage or entering one with the œsophagoscope. At the crico-pharyngeal constriction fatal œsophagoscopic perforation by inexperienced operators is very likely to occur. Here there is a weakly supported area in the œsophageal wall. Richardson (Dennis, System of Surgery, vol. iv, p. 233) refers to the liability of impaction of instruments used by mouth, thus requiring œsophagotomy for their release. Such are the dangers observed in every-day practice and avoided only by expert knowledge and perfected technic.

However, in spite of these discordant facts, endoscopic procedures for the extraction of foreign bodies in the œsophagus are generally considered preferable to, and safer than the operation of œsophagotomy providing the œsophagoscopist possesses adequate skill and equipment. Nevertheless, a method known to be safe in the hands of one possessing the necessary attainments may prove an unhappy adventure for another, ill-qualified by lack of training

and experience. The most able exponents of œsophagoscopy invariably refer to the " skill of the operator " as the *sine qua non* for success. By this reference I am sure that just ordinary skill is not implied. It is not to be construed as that degree of skill possessed by the average capable laryngologist. Even the moderately difficult cases demand talent, ingenuity, adroitness, perhaps consummate skill acquired only after many years of convergent practice.

In his chapter on " Acquiring Skill " Jackson remarks, " Endoscopic skill

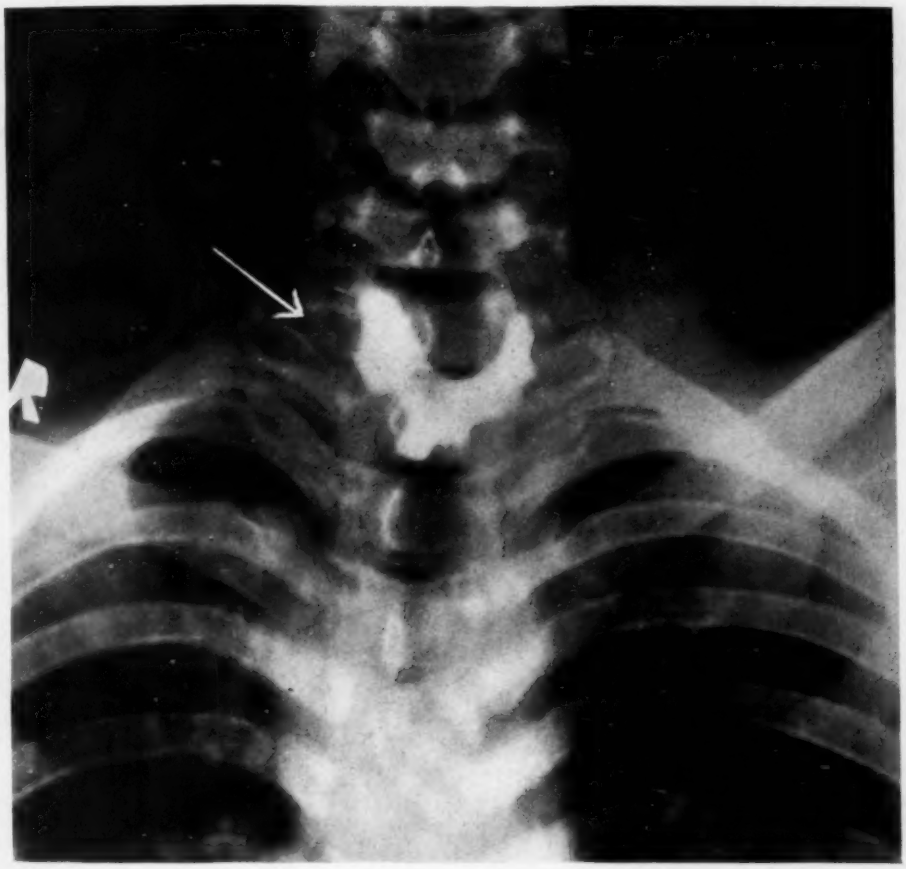


FIG. 1.—Tooth-plate in œsophagus. Removed by œsophagotomy.

cannot be bought with the instruments. Repeated exercise of a particular series of manœuvres is necessary. As with learning to play a musical instrument, a fundamental knowledge of technic, positions and landmarks is necessary after which only continued manual practice makes for proficiency. Endoscopy is a purely manual procedure, hence, to know how is not enough, manual practice is necessary. Practice on the cadaver, on the rubber-tube manikin, and finally upon dogs, should be pursued for the education of the eye and the fingers. It is inhuman and impossible to obtain the preliminary experience on the living subject."

Providing a patient must receive prompt relief and is located in a district

remote from an endoscopic clinic, the method of dealing with the situation is of prime importance, because it is likely to make all the difference between a triumph and a fatal failure. No doubt more of these cases can wait and be transported long distances than exigencies of the situations usually appear to warrant. Notwithstanding this fact, the picture presented by a patient strangling, choking and partially stifled by a large foreign body

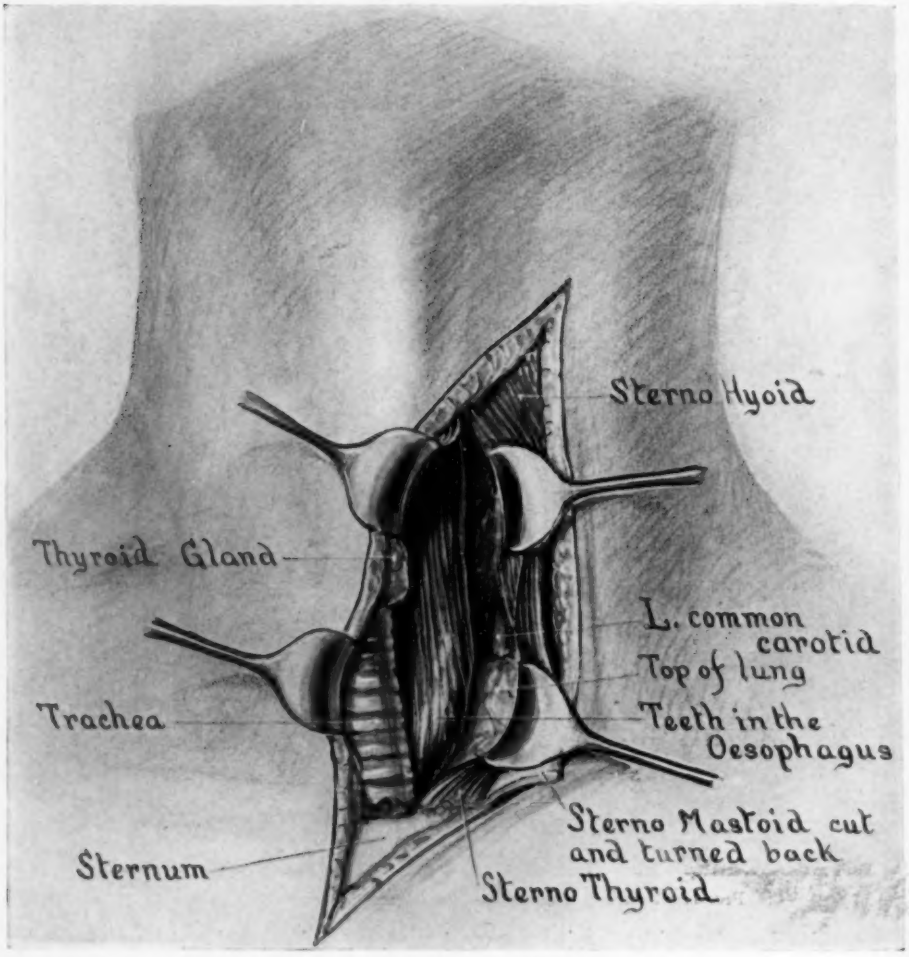


FIG. 2.—Structures met in approaching the œsophagus.

arrested in the œsophagus is sufficient cause for infirmity of purpose, fright and even panic on the part of his attendants. Four such cases have occurred in our community. Three are known to have died after bloodless methods at first presumably conservative, then followed by œsophagotomy.

The fourth case a male aged twenty-three was brought to our hospital from Warren, R. I. on September 6, 1923, two hours after he had accidently swallowed a partial denture of the upper jaw. No attempts had been made to dislodge the plate except by the patient

himself. He tossed about ceaselessly in efforts to move the foreign body up or down. Upon examination his appearance showed evidence of exhaustion and prostration. He was dyspnœic and salivated freely. There was moderate swelling of the neck and marked tenderness at the suprasternal notch. Otherwise his physical condition was good. Pain was severe and persistent requiring hypodermic injections of morphia. The Röntgen film, Fig. 1, showed a dental plate in the œsophagus arrested opposite the 7th cervical vertebra and about at the aperture of the thorax.

A conference was held among members of the hospital staff and by telephonic communications with Dr. Chevalier Jackson of Philadelphia and Dr. Crosbie Greene of Boston, after which we reached the conclusion that under the circumstances the open operation offered this patient the best chance for recovery. Our decision was based upon the following premises

FIG. 3.—Deeper structures met in approaching œsophagus.

(a) The foreign body was large, horseshoe in shape, with rough edges and impacted in the cervical portion of the œsophagus. (b) It was definitely localized and accessible. (c) The patient was dyspnœic and weary. He could not swallow water without convulsive effort causing an aggravation of pain and soreness. (d) He was a young healthy adult with a long, lean neck and no enlargement of the thyroid gland. (e) No trial procedures had been undertaken, hence no complications had been superimposed. (f) Available for the operative effort were a laryngologist and a general surgeon. The former was very capable of doing those operations usual in the practice of laryngology but lacked expert familiarity with the use of the œsophagoscope. (g) There was neither equipment nor trained assistants with which to venture an endoscopic procedure.

Dr. Crosbie Greene recommended œsophagotomy. Dr. Chevalier Jackson believed that the denture could be removed by mouth but that local conditions should help determine the plan of operation. Inasmuch as about ten hours had elapsed since the first X-ray examination, another exposure was made because of the remarkable fact that many irregular foreign bodies including dental plates are known to have passed through the entire alimentary canal without injury to the patient. Lediard (Clin. Soc. Trans., vol. xviii, p. 297) records a case in which the dental plate appeared at the anus nineteen days from the date of impaction. In our patient the foreign body had not changed its position. Therefore it was decided to proceed with the operation of œsophagotomy.

The patient was etherized and placed in the Fowler position with head extended and

turned to the right. The skin was painted with iodine after which an oblique incision was made following the anterior border of the left sterno-cleido-mastoid muscle and carried down over the sternum for a distance of 5 cm. (Fig. 2). Extending the incision down over the sternum proved advantageous in providing the maximum amount of room where it was needed most. After dividing the cervical fascia approach to the œsophagus was made through the lower carotid triangle guarding against injury to the structures contained therein. The sternal origin of the sternomastoid was severed and the muscle freely mobilized. The carotid sheath with its enclosed vessels was exposed as these structures merged from the superior thoracic aperture. (Fig. 2.) The sternomastoid and large vessels were drawn to the left and the trachea to the right, with retractors, the thyroid gland showing plainly over the trachea. (Fig. 3.) Care being taken to avoid injury of the recurrent nerve, Fig. 4, the loose cellular tissue was separated by a method of blunt dissection and the œsophagus exposed. At this point the pleura was nicked and disturbed the even course of events. With this repaired the location of the dental plate in the œsophagus could be defined readily. Although the foreign body was fixed there was no evidence of puncture. Before incising the œsophagus a small sponge soaked in 70 per cent. alcohol was packed in the wound long enough to afford some protection against infection. The vertical incision in the œsophageal wall was made somewhat far back in order to avoid the recurrent nerve. Through a 4 cm. opening, Fig. 5, it was with considerable difficulty that the dental plate was dislodged and extracted, so tightly was it embraced by the œsophageal fibres. This experience was not unique for Mr. George Lawson (Clin. Soc. Trans., vol. xviii, p. 292) in a similar operation found the plate so firmly fixed into the wall of the œsophagus that it required division with bone forceps before its removal was possible.

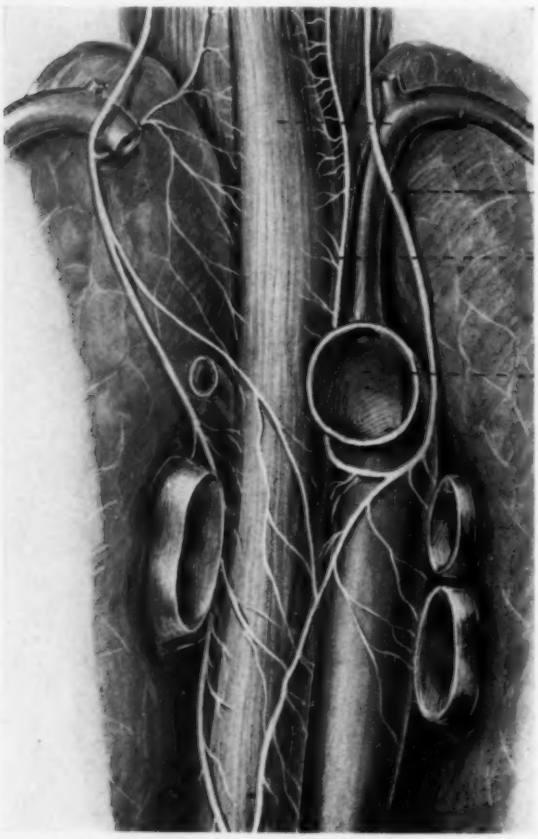


FIG. 4.—Relations of recurrent laryngeal nerve to arch of the aorta and œsophagus.

The opening in the œsophagus was then closed with a double layer of interrupted sutures of fine silk. A rubber tissue drain was placed in the lower angle of the wound. The skin sutures used only at the upper angle were removed on the fourth day. The patient was nourished by means of a Rhefuss tube. A small œsophageal leak appeared

on the seventh day. This closed in three days. He was discharged on the sixteenth day. There remained only a superficial granulating area. Deglutition was natural and the voice remained normal. At the end of six months he appears to have no stricture of the œsophagus and suffers no inconvenience from the scar.

The dangers of œsophagotomy for foreign bodies are by no means negligible. The primary risk of the operation is considered to be large. The chief causes of death are hemorrhage, shock and infection. Injury to the recurrent laryngeal nerve is not uncommon. Mr. Cock (Jacobson and Steward, vol. i, p. 563) reported a case of this sort. The patient was a singer. As a result of this accident his fine tenor voice was replaced by a bass. Stricture of the œsophagus may also follow the operation. The mortality, however, cannot be considered very high among the surgeons who first performed this operation. Of 135 œsophagotomies reported by Egloff (Beitrage zur klin. Chir., 1894, p. 143), dating from the first case by Goursald in 1738, to 1894, 100 recovered. Of operations performed in the first three days, 46 showed a mortality of 19.5 per cent. Most of these operations were performed by German surgeons.

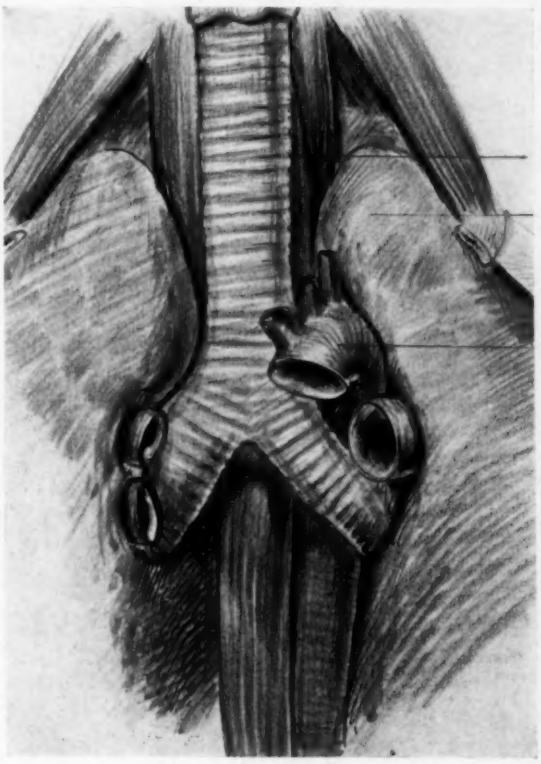


FIG. 5.—Mediastinal space showing proximity of parietal pleura to œsophagus.

It is doubtful if the high mortality, 20 per cent. to 42 per cent., referred to by Chevalier Jackson (*Ibid.*, p. 185) represents the results of this operation in the hands of experienced surgeons under favorable conditions. It is more probable that this high mortality rate can be attributed to "overtreatment" in attempts at extraction by the many so-called "justifiable" procedures with probang and œsophagoscope so commonly advocated as first aid. Even under the guidance of skilled hands any prolonged instrumentation of the œsophagus must react unfavorably upon the chances of success by œsophagotomy.

Time which passes rapidly for the operator, is long and wears heavily upon the patient. Only the skilled endoscopist knows when to stop in the use of conservative methods. When the physician or laryngologist is convinced after a multiplicity of manœuvres that he cannot extract the foreign body, the patient may be fatally injured. The neck from its external aspects may not present ominous signs but danger lurks within. Trauma and exhaustion have done their part and surgery completes an ignoble record. When the foreign body is large, irregular and impacted, will there not be a better chance for the patient's life if œsophagotomy is done by a surgeon familiar with the anatomical parts to be met, than if extraction by mouth is undertaken by one who does not possess the proper instruments and has not thoroughly mastered the technical difficulties which the procedure entails?

These accidents happen many hundreds of miles from endoscopic clinics yet there are few regions where a capable surgeon cannot be reached within fifty miles. Whenever there is a possibility that the open operation may have to be done, would it not be more logical to study the case from every angle with a view to selecting the safest method available. That method may not represent the last word in the technical features pertaining to the treatment of these cases, but on certain occasions the first-born method may be found more expedient, fully as trustworthy and even less precarious. If œsophagotomy is undertaken only after "bloodless" methods fail, necessarily the mortality must be very high. Under favorable conditions it should not exceed 5 per cent.

In order that the open operation may have the best chance for success when it is indicated, it is essential that no preliminary probing of any sort by mouth be allowed. That feature more than any other contributed to the success of the case which I have reported. Surgery in this, as in the treatment of many other diseases, must not be chosen as a last resort if the aim is to save life. Although well nigh obsolete, I believe œsophagotomy is still a precious procedure in wisely chosen cases of foreign body in the œsophagus and the success of this operation is never enhanced by trial measures which shatter a patient's stamina and induce prostration. To have its fair chance in this particular dilemma, œsophagotomy must be given an unbroken field at the start.

END RESULTS IN SOME CONDITIONS ASSOCIATED WITH OR POSSIBLY CAUSED BY GOITRE*

By Martin B. Tinker, M.D.

of Ithaca, N. Y.

The end results reported by Charles H. Mayo, Crile, Ochsner, Frazier, Judd, Pemberton, Lahey, and others have covered nearly all points thoroughly and have convinced the medical profession and the public of the value of goitre surgery as is evidenced by the yearly increasing number of operations. There remain, however, a few questions which have been given relatively little, if any, attention in surgical literature, and to these I shall mainly devote this paper. It is perhaps unnecessary to give much time to discussion of methods of obtaining data as to end results; yet I may mention that living in a small community in frequent and close touch with people who are permanent residents gives often a somewhat different impression as to results than a single hurried examination or reply to a questionnaire. Our records show that of a total of two thousand and twelve cases operated upon by our present methods, approximately half come from Ithaca and a radius of 100 miles of surrounding territory. The condition of these patients is known not only by replies to a questionnaire, but in most cases by frequent personal examination, also by reports of friends and neighbors, and reports by patients' doctors. Many in all groups discussed in this paper and all in some groups have been examined personally. The importance of reporting progress is urged upon all patients during their stay in the hospital; it is also emphasized on the printed slip giving suggestions for after-care which is handed to patients on discharge, and a geographical card index of patients helps us to get reports from neighbors who come for treatment. Most of our patients are an intelligent class of people who coöperate satisfactorily in reporting end results and realize that it is frequently to their own benefit, as well as others similarly afflicted.

Pregnancy.—A number of times every year I am asked, "What would be the probable effect of pregnancy on the results of operation for goitre; would thyroid enlargement and the symptoms probably return as the result of pregnancy? Would the child show any physical or mental abnormalities as a result of thyroid lack in the mother? Would iodine, thyroid extract, or other medication be desirable during pregnancy?" The impression seems quite general that pregnancy generally does precipitate hyperthyroidism or induce permanent thyroid enlargement or both, but very little has been reported from the basis of actual clinical experience on this subject. I have reliable information as to the condition of twelve patients, pregnant at the time of, or subsequent to partial thyroidectomy; all have gone through their pregnancies to full term and all have given birth to healthy children. One

* Read before the American Surgical Association, April 17, 1924.

has given birth to three children; two have given birth to two children; eight have given birth to one child since operation: a total of fifteen children. These patients were operated upon from three to eleven years ago, and only one has required further surgery. This patient was first operated upon at the time when most of us were doing hemithyroidectomy because of fear of post-operative cachexia strumipriva. She had considerable enlargement of the left side at the time of the first operation, and returned because of further enlargement and pressure symptoms. A further partial thyroidectomy was done from which she has made a satisfactory permanent recovery, now four years past her final operation. Another patient, personally examined a few days before writing this paper, has a slight enlargement which does not warrant operation at this time. The remaining nine remained apparently entirely well. Five of the number originally had disfiguring or obstructive growths; three were toxic adenomatous goitres; one very toxic exophthalmic. Four were examined as to end results personally, one by an assistant, and four reported by letters. Of three patients who were pregnant at the time of operation; one was operated upon at three months because of obstructive symptoms; another was operated upon at seven months because of suppurative thyroiditis; attempts at relief by drainage without radical surgery were unavailing and most of an extensively infiltrated gland was removed with considerable difficulty; recovery was rapid in both cases and they remain well three and five years after operation. The third patient had a highly toxic exophthalmic goitre and elected partial thyroidectomy rather than abortion at five months; her pregnancy went to term and she gave birth to a healthy child, and has since safely gone through another pregnancy; both of her children are normal and she remains in good health eleven years after operation in spite of the somewhat trying conditions of the life of a Missionary in China.

So far as can be judged from so small a number of cases, the end results seem to justify the conclusion that thyroid surgery need have no evident effect on children born at a subsequent pregnancy; that there is not much tendency to return of symptoms or enlargement; and that operation during pregnancy is not particularly dangerous.

Menstruation.—As to menstrual function: there is complete cessation of periods for from three to six months or longer in practically all of the extremely toxic adenomatous and exophthalmic goitres which we see. In no instance under my observation has this been permanent and the return of menstruation occurs as soon as the patient is well on the road to recovery. At first most of the patients are greatly disturbed over the cessation of menstruation and inquiry as to probable outcome must come to almost everyone who sees many toxic goitres.

Profuse menstruation as the result of lack of normal thyroid secretion has not been reported to us in a single instance. The danger of myxœdematous changes as a result of thyroidectomy is probably greatly overestimated. Osler, who no doubt had under observation as large a number of patients as any consultant of his time in this country, in at least two editions of his text-book

stated that post-operative myxœdemata is very infrequent, that he had observed only two such cases, and that one of these cleared up under treatment. Probably surgical methods and results have greatly improved since this statement was made.

Exophthalmos.—My impressions as to ultimate results with exophthalmos have radically changed within a few years. The results as regards appearance of the eyes following operation upon patients with extreme exophthalmos are often discouraging even after four or five years have elapsed. As with other symptoms, the cases of long standing improve more slowly and less surely, but observation of late end results leads me to believe that in many cases exophthalmos continues to lessen, even long after the general physical condition has come back to normal. In thirty-nine cases examined by me or my assistants seven to fourteen years after operation, the eyes of thirty-one are normal, or so nearly so that they would not be noticeable to the average observer. All of these patients live near Ithaca and most of them have been seen frequently. Few of these extreme cases showed much improvement in the first three years and some retained noticeable exophthalmos for five years. While I formerly told patients with very prominent eyes that the prospect of improvement was doubtful, on the basis of observation of later end results, I now tell them that they have at least three chances out of four of ultimately getting fairly normal eyes.

Advanced Age.—What should be advised in the case of an aged person suffering seriously from goitre is often a difficult question. The distress caused in some of these cases is indicated by the fact that patients as old as eighty-six have come for consultation to consider surgical relief. Of course no sane surgeon advises operation for any condition with a patient advanced in years unless the indications seem urgent, hence, experience as to end results in older goitre patients is limited. The widespread impression both in and out of the profession that lack of thyroid secretion influences the development of senile changes has doubtless led most of us to be especially slow to meddle with the thyroids of older people. Yet, my own experience in operating upon thirty-one patients over sixty, who we have been able to follow, leads me to feel that possibly there is quite another side to the question. The indications for operation seemed definite in all of these cases: Nineteen had obstructive symptoms, eleven had adenomata with quite a high degree of toxæmia, and one was malignant. Of fifteen patients between sixty and sixty-five years of age, three have died; one from local recurrence of malignancy (small round-cell sarcoma); one from operation at another clinic for enlarged prostate; and one from apoplexy. The remaining twelve are living and well; eight of these patients are from five to eleven years past operation; one patient now seventy-one years of age is nine years past operation; one seventy-six years of age is eleven years past operation. Three patients were over sixty-five years of age at the time of operation; one of these patients died from unknown cause; one is living at sixty-nine years of age; one patient operated upon for serious obstructive symptoms when

seventy-two years of age was living at last report, with failing eyesight but otherwise well, over eighty years of age. Many of these patients looked thin, almost to emaciation; pale, gray, and even older than their years. Many of them looked ten years younger before leaving the hospital and all considered themselves greatly benefited. Is it not possible that the drive of an overactive thyroid for years causes rapid wearing out quite as frequently as thyroid lack precipitates senile changes?

Childhood and Adolescence.—The important influence of the thyroid in development, both physical and mental, rules out surgery in childhood and adolescence except in cases presenting urgent symptoms, but harmful results have not appeared in any of my patients operated upon when under twenty years of age. Twenty-eight cases are included in this group. Avoidance of unfortunate end results seem to me to be dependent upon leaving a fairly liberal strip of thyroid tissue with unimpaired blood supply from at least two of the four main arteries. Dr. W. S. Halsted's early work showed conclusively that dogs with a small amount of thyroid with normal blood supply at one pole are capable of hypertrophying the stump to supply the needs of the animal.

The strip saved should be along the posterior surface of the gland over the great vessel sheath and along the trachea and larynx in order to avoid injuring the parathyroids and the recurrent nerves. With this precaution none of my younger patients have developed any evidence of thyroid or parathyroid lack. The youngest patient was a little girl operated upon at three and one-half years of age because of serious symptoms of obstruction in breathing. She made a perfectly satisfactory recovery and at last report was well eight years following operation. A girl of fourteen years of age operated upon because of an extremely toxic exophthalmic goitre has remained entirely well fourteen years since operation, the longest of any of my children patients. She had developed from a child into a very attractive young woman, has taken an Art Course with credit, and is now a successful illustrator, is married and remains entirely well.

Glycosuria.—Approximately 5 per cent. of all toxic goitre patients coming under my care have a trace of sugar in the urine. In all cases these small traces have cleared up with attention to diet and recently occasional use of insulin, while the patients have been in the hospital, and the end results three to fifteen years after operation show no evidence of trouble from this source. There are fifty-three patients in this group. On the other hand, patients with high percentages of sugar in the urine and high blood sugar associated with toxic goitre usually do badly. Three such patients have died without any surgery within a week of admission to the hospital, in spite of the best medical care available. Three have been sent back to their home physician. Another three, exactly 33⅓ per cent. in my limited experience, have been brought sugar free under medical care, have had preliminary ligations followed by later excision and remain well without very strict medical supervision, although they are requested to report regularly for urinalysis and occasionally blood sugar

estimation. To summarize my own experience: the lower percentages of sugar have cleared up before operation, remaining permanently free after operation without special attention to diet or medication: in case of high percentages of sugar, associated with toxic goitre, two-thirds of the patients die without operation; while when higher percentages are cleared up by diet, insulin or a combination of the two sufficiently to warrant operation the patients do well, requiring little medical attention to keep them sugar free.

High Blood Pressure.—Several writers on blood pressure state that the administration of thyroid extract usually causes a fall in blood pressure, although in certain instances blood pressure is increased. This belief that thyroid secretion usually lowers blood pressure has probably led to the assumption that removal of goitre would have an unfavorable influence on high blood pressure, for of course a certain amount of normal thyroid tissue is removed, even with large adenomatous and colloid goitres. As a matter of experience, dangerously high blood pressures are frequently favorably influenced by thyroidectomy. Until recently I have not operated upon patients with very high blood pressures, hence the end results do not date back in most of my cases more than to five years. Patients with blood pressures over 180 are invariably given preliminary treatment, rest in bed, low protein, salt-free diet, and free purgation. In the case of patients with pressure above 200 systolic, we have not operated unless it was possible under treatment to reduce the pressure to 190 or lower. In eleven cases with pressure above 200 systolic, there has been such immediate and striking improvement after thyroidectomy, that it seems fair to attribute the patient's improvement to operation. In one instance the blood pressure dropped immediately from 200 to 150 and later was reported by the patient's home physician at 120; in another instance the drop was from 220 to 140; a third patient dropped almost immediately following thyroidectomy from 240 to 150, and still further improvement has been reported since this patient returned to her home. The less encouraging side of the question is that two patients have died from apoplexy within a few months after leaving the hospital and in the remaining twenty patients the improvement has not been greater than would be expected from such restriction of diet and general care as it has been possible to enforce. Thus far, we have been unable to discover any criterion enabling us to select those patients with high blood pressure who would be benefited from those in whom no improvement could be expected. There has been unquestionably a very striking immediate, and thus far permanent, improvement in 30 per cent. of the high blood pressure cases. If a three years' period may be considered an end result, the end results are good in this proportion of my cases. It seems to me that this condition is deserving of careful study by laboratory as well as clinical workers.

These are but a few of many unsettled problems which must come to anyone seeing considerable numbers of goitre patients. The wide experience of many members of this Association should add much toward their solution.

END RESULTS OF GOITRE OPERATIONS*

By Albert J. Ochsner, M.D.
of Chicago, Ill.

The following plan was carried out in order to determine, as nearly as possible, a fair idea of end results in this type of cases. A questionnaire containing the following inquiries was sent to the addresses of 1200 patients upon whom Dr. N. M. Percy and I had operated at the Augustana Hospital for exophthalmic and toxic goitres during ten years, ending January 1, 1923, so that none of the answers included came from patients operated upon less than fifteen months ago:

1. Have you been well since returning home from the hospital?
2. How long were you weak after returning home from the hospital?
3. Have you followed directions on diet list?
4. Have you continued drinking boiled or distilled water?
5. Have you any disturbance of the heart?
6. Have you gained in weight?
7. Have you had any new complaints since leaving the hospital?
8. Please give a general description on space below of how your health has been since leaving the hospital?

The following table gives an analysis made by our colleague, Dr. O. E. Nadeau, of the answers received from the first 500 patients who sent in their reports. Later the remaining answers will also be analyzed. It seemed sufficient for the present paper to analyze this number:

ANALYSIS OF 500 REPLIES TO QUESTIONNAIRES IN CASES OF TOXIC AND EXOPHTHALMIC GOITRE

Ages	Cases	Duration of weakness after operation Months		Years	
11–20	48— 9.6%	1 month or less		1	42
21–30	129—25.8%	2 months	96	2	24
31–40	123—24.6%	3 months	69	3	3
41–50	105—21.0%	4 months	27	4	3
51–60	73—14.6%	5 months	12	5	1
61–70	19— 3.8%	6 months	36	6	2
71–80	3— 0.6%	7 months	7	7	0
		8 months	3	8	1
		9 months	2	9	1
		No mention	17		

Symptoms recurred after operation similar to some of those experienced before operation—119.

Those who followed directions constantly 278, but symptoms recurred in 73.
Those who did not follow directions constantly 207, but symptoms recurred in 41.
Those who drank boiled water constantly 154, and symptoms recurred in 38.

* Read before the American Surgical Association, April 17, 1924.

Those who did not boil water constantly 337, and symptoms recurred in 77.

Those who had recurrent symptoms but did not mention diet 5.

Those who had recurrent symptoms but did not mention water 4.

Disturbances of heart. Yes—125; no—357. No mention—18.

Voice affected temporarily 5, permanently 1. Recurrent tumor of neck, 35. Persistent exophthalmos, 44. Worse after operation, 8.

Deaths.—2 months—1; 7 months—1; 9 months—1; 2 years—2. Of these 1 died of carcinoma of the stomach. 3 years—3. Of these 1 died a suicide from melancholy. 4 years—1. Of these 1 died of diabetes. 5 years—1. Cause not mentioned. 6 years—1, who died of diabetes. 9 years—1. Cause not mentioned.

Patients who stated they felt better when following strict directions—21.

Unusual Complications.—One case has unilateral exophthalmos (dextra) six years after operation. Two cases (male) developed insanity one and one-half years after operation.

It will be seen that 70 per cent. of our cases were between the ages of twenty and fifty years, and that 64 per cent. had regained approximately normal strength within three months following the operation, while 15 per cent. remained weak for more than one year.

In 24 per cent. some of the symptoms present before the operation had either persisted, or they had recurred, since the operation, but with the exception of the twenty-one cases noted specially below, eight of whom were worse and three who died within one year following operation, all of this group of patients were better in some respects than they had been before the operation, although none of them were well.

During this period of ten years we have given each patient the following printed list of directions upon leaving the hospital with the hope of improving the prognosis:

1. Avoid excitement or irritation of every kind. If anything happens to annoy you, put it off for a week. Never do anything in a hurry or long enough to become really tired.

2. You should get an abundance of rest, by going to bed early, not later than 9 P.M., and taking a nap after luncheon.

3. You should get an abundance of fresh air, especially at night, consequently you should sleep with wide open windows, or on a sleeping porch.

4. You should drink nothing that irritates the nervous system, like tea, coffee or alcohol. Of course you should not use tobacco in any form.

5. You should eat very little meat. If you are very fond of meat, take a little beef, mutton or breast of chicken or fresh fish once or twice a week, or at most, three times a week.

6. You should drink a great deal of milk, or eat things that are prepared with milk, such as milk soup, milk toast, etc. Cream and butter-milk and Horlick's malted milk are especially good for you.

7. You should avoid beef soup or beef tea or any kind of meat broths.

8. You should eat an abundance of cooked fruits and cooked vegetables of every kind, or very ripe raw fruits, or drink fruit juices prepared out of ripe fruits.

9. You may eat eggs, bread, butter, toast, rice, cereals.

10. You should drink an abundance of water boiled for twenty minutes, distilled water may be used in place of boiled water. Do not drink unboiled water.

The table shows that the majority of these patients have not followed these directions constantly since leaving the hospital and that there was practically no difference in the percentage of complete cures between those who did and those who did not follow these directions, except that twenty-one patients stated definitely that they felt better when they followed the directions strictly.

Twenty-five per cent. of our patients still suffer to some extent from tachycardia, or some other form of cardiac disturbance.

Five patients, or 1 per cent., had some disturbance of the voice for a time, which has, however, completely disappeared, while in one patient it has persisted to some extent.

There was a recurrence of the goitre in 7 per cent. of the cases, and all of these had returned to their former mode of living, including the drinking of unboiled water.

Exophthalmos persisted in 9 per cent. of the cases. In one case a right-sided unilateral exophthalmos has persisted for six years. Three cases died within one year after the operation. Twelve died from two to nine years after the operation from diseases not connected with their goitres. Aside from these only eight cases, 1.6 per cent. of all cases, were worse after the operation than before.

It has been possible to make a personal examination of only a proportion of these patients in order to compare their present condition with the records of their pre-operative condition, which would, of course, be necessary to make a report of end-results satisfactory. All of the cases that I had an opportunity to examine personally showed a marked improvement over their pre-operative condition even in case of the presence of some unfavorable symptoms, but this may have been simple coincidence, and may not hold true for those not personally examined.

REPORT OF THE RESULTS OF OPERATION ON A GROUP OF 150 CASES OF GOITRE*

By Charles N. Dowd, M.D.
of New York, N.Y.

The effort of the Executive Committee of the American Surgical Association, to promote late reports on the results of treatment for goitre, is surely a commendable one. There is hardly a subject which is more written about in surgical literature, than goitre; and the effort to solve the goitre problem is attracting the energies of a very large number of competent men; but in proportion to this great activity, there has been too little attention to the late results of the different forms of treatment.

Wishing to add a little to the subject, I have endeavored to study the later condition of 150 patients, on whom I have personally operated for goitre between 1899 and 1924. The report is confined to personal cases, because they give better opportunities for study than we are able to obtain from groups which represent the work of several surgeons on a Hospital Division. They represent all the patients on whom the writer has operated for goitre during this period.

In addition to these cases many others have been treated by medication or rest or hygienic regime or by X-ray. Most of them have passed out of observation but have shown certain peculiarities which are referred to in the text.

The types of goitre have varied from acute hyperplastic goitres of overwhelming toxicity to encapsulated cysts with little or no toxicity. Toxic adenomata, however, were more common than any other type.

There were also two cases of cancer which are not included in the list, because only diagnostic incisions were made.

All but five of the patients have been traced since leaving the hospital. The periods of observation are indicated in the following table:

Followed into 21st yr.	1 patient	Into 9th yr.	9 patients
Followed into 20th yr.	1 patient	Into 8th yr.	13 patients
Followed into 17th yr.	1 patient	Into 7th yr.	8 patients
Followed into 16th yr.	2 patients	Into 6th yr.	13 patients
Followed into 15th yr.	4 patients	Into 5th yr.	17 patients
Followed into 13th yr.	2 patients	Into 4th yr.	14 patients
Followed into 12th yr.	4 patients	Into 3rd yr.	17 patients
Followed into 11th yr.	3 patients	Into 2nd yr.	16 patients
Followed into 10th yr.	7 patients	Into 1st yr.	8 patients

The reports have been made by the writer from personal observation in 83 instances; by another physician 11 times; by the patient either by letter or telephone conversation with the writer 26 times; by a nurse 6 times; by the patient's relative or friend 14 times.

* Read before the American Surgical Association, April 17, 1924.

Kinds of Operations.—The operations have been done primarily with the view to adjusting the operative procedure to the patient's strength, but with the ultimate purpose of removing as much of the thyroid gland as the patient could spare without endangering the normal thyroid function. In most instances, four-fifths of one lobe and from one-third to three-fourths of the other lobe have been removed. A primary ligation of one or both superior thyroid arteries has been done in twelve instances. Usually this has been followed by the removal of a large portion of the enlarged gland. Occasionally no further operation than the ligation has been practicable or even desirable. As the work has progressed, it has been possible to gauge the patient's strength in such a way as to keep within fairly safe limits in the selection of operative procedure.

"Standards for Estimating Results."—In estimating the results of these operations, we have based the reports on the ability of the patient to perform the ordinary duties of life. We believe that this is the most important standard. The patients who come to us with goitre wish to be cured of their disabilities, so as to have at least the ordinary capacity for work and enjoyment. A result short of this is not satisfactory, no matter what the pulse-rate, or basal metabolism or bodily weight. If, however, these patients are able to carry on the ordinary duties and pleasures of life in comfort and health, the results may be considered satisfactory.

It is important to have a mental picture of the entire group of patients; thus endeavoring to show what may be expected of such people after their operations.

We have, therefore, classified them into five divisions:

1. Operative fatalities.

2. Patients who have died either of intercurrent disease or from results of goitre since leaving the hospital.

3. Patients who are definite invalids.

4. Patients who are able to do a moderate amount of work and to enjoy life but habitually have to guard against over-exertion.

5. Patients who really enjoy life and have at least the average capacity for work or other activities.

Fortunately, the latter group preponderates in a large majority. If we consider those patients who have been observed since leaving the hospital, 73.6 per cent. belong to this group. An additional 22.8 per cent. are grouped with those who can enjoy and do a moderate amount of work but have to guard against over-exertion.

In order to explain these divisions, we may refer to some of the patients in detail.

Division 1.—*Operative fatalities*—five patients. The first three had advanced Graves' disease in its extreme form. Their ages were, respectively, twenty-three, twenty-six, and sixteen years. They had exophthalmus, palpitation, sweating, extreme nervousness and very rapid hearts. One of them died on the table before even a ligation could be completed. Another died

three days after operation with œdema of the lungs and the other on the third day after operation, having "rusty" sputum and signs of pneumonia.

In view of subsequent experience, operation would not have been attempted on these patients in the conditions which they then showed. These three fatalities occurred among the first thirty-three cases. It is possible that a preliminary ligation of a single superior thyroid artery at a properly selected time without even removing the patient from bed, might have been successfully done for one or all of them and that further procedure could have been accomplished later.

It is to be noted that in the next 117 cases there were only two deaths. One of them a girl of twenty-three, who had suffered from hyperplastic goitre for several years and had undergone several operations, died after an effort to remove a part of the remaining left lobe of the gland. The other was a patient who beside her goitre had mitral regurgitation and a dilated heart. She was kept in the hospital for twenty days before operation, and although her heart lesion was well understood, the operation seemed advisable. She went through the operative procedure without incident. Her pulse was about 90 throughout the operation and she seemed to do well until the evening of that day, when she suddenly died. The physician who observed her at that time thought that her death was due to a coronary embolus. Every surgeon who is not excessively timid has to take an occasional risk of this sort. When, however, we consider that there were 117 consecutive cases with only these two deaths, we may appreciate that we are dealing with a very low operative mortality.

In considering this group of fatalities, we are impressed with the deadly character of the disease in the first four of these patients and our great regret is that their thyroids could not have been attacked before their hyperplasia had led to such serious symptoms.

Division 2.—*Patients who have died since leaving the hospital,* either from progress of the *goitre* or *from intercurrent disease.* Four patients: One thirty-three years of age, who had suffered from goitre for seven years, and who had reached the stage of degeneration of her internal organs. She was kept in the hospital for 29 days, resting in bed and having symptomatic medical treatment. Her basal metabolism varied between 64 and 39. The superior thyroids were then ligated without incident; one at a time, under local anæsthesia, in her bed. She improved considerably but insisted on going home. She died a month later in another hospital from so-called "heart disease."

The second case was a girl of nineteen years, with a moderate-sized goitre, exophthalmus, basal metabolism plus 37 and hereditary syphilis. Her two superior thyroids were ligated and she improved satisfactorily so that at one time I was willing to undertake subtotal thyroidectomy. Her guardians, however, refused this and she went from the hospital. She was under X-ray treatment for more than a year. She finally died with apparent degeneration of her internal organs.

The third case died about a year after leaving the hospital, from "cerebrospinal meningitis." Her physician stated that she did not then give signs of hyperthyroidism.

The fourth case had both superior thyroids ligated in March, 1917. No further operation was done at that time. She was then extremely toxic. She existed for several years in a condition of invalidism, going from one hospital to another, having long treatments of X-ray, etc. In February, 1924, an effort at operation was made in another hospital and she died immediately following the operation.

It should be noted that ligation of the superior thyroid arteries was successfully accomplished for three of these patients and that they then either would not or could not have further surgical procedure and that the disease progressed in each instance. The fourth apparently died of disease not associated with her goitre.

Division 3.—*Patients of the Invalid Class.* I find only one patient in this group. He, too, refused further operation after his superior thyroid arteries had been successfully ligated. He is a man of twenty-six, who was first seen six years ago, having then had his goitre for three years. He had exophthalmus, tremor, weakness, extreme "nervousness," sweating and rapid pulse. Both superior thyroid arteries were ligated. Improvement followed, but he refused further operation. He tried to work as a clerk, but was unable to continue. In February, 1920, the right inferior thyroid artery was ligated by another surgeon. He then made another unsuccessful effort at light work. He was in another hospital for six weeks in 1921. He was seen in February, 1922, and was then weak and suffering from sweating, dilated heart, palpitation, tremor, and his neck was 16½ inches in circumference. He was then three months in another hospital and had twelve X-ray treatments, improvement followed. He then tried again to do clerical work, but when seen by his physician, March, 1924, had been unable to continue even light work. It is hardly fair to consider him a case of operation. He let his opportunity pass when he refused partial thyroidectomy after his preliminary ligations.

Division 3.—*Patients who are able to do moderate amount of work and enjoy life but have to guard against over-exertion.* There were 32 patients in this group. They were all definitely better than before their operations. Several of them were better than we could fairly expect. Three cases may be cited for illustration, although others in the group were much stronger than these were. A woman of thirty showed marked invalidism from the ordinary symptoms of toxic goitre. After subtotal thyroidectomy and a period of rest in the hospital she regained her health and seemed to be normal for nearly four years. She then suffered from a post-partem hemorrhage. During the following two years her strength has only been moderate, but she has been able to carry on the ordinary duties of life. Another patient twenty-eight years old with severe Graves' disease had her superior thyroid arteries ligated separately under local anæsthesia in 1912 with an interval of seven days between the two ligations. This was followed four months later by

hemithyroidectomy. During the following six years she was not able to do much. During this period her disability was increased by family sorrow. She then gained strength and during the intervening years has been able to support herself and help care for her mother.

Another patient, forty years old, made an excellent recovery and was able to return to usual family and social activities. There followed a period of stress owing to misfortune in the family and corresponding period of depression and limitation of capabilities. Now for three years she has been reasonably active and carefree.

These cases represent the least capable part of the group. Without the operation, I believe that most of them would have collapsed under their trials or would have been useless invalids.

Division 5.—*The group of patients who really enjoy life and have at least the average capacity for work or other activities.* This is by far the largest group, representing, as before stated, 73 per cent. of the patients who were traced after leaving the hospital, or 68 per cent. of the entire series, including untraced and fatal cases. Many of them have much more than the average capacity for exertion. For instance, case No. 94 announced that "before operation" she could not climb stairs or raise her arm high without distress or "do much of anything," but that now at the age of forty-nine, five years after operation, she can do more than she had ever been able to do before, attending to her own house work and taking part in various activities. Case No. 59 reported eight years after her operation that she is caring for four children and husband, a big house and garden, and stated with much pride that on the day before she had washed twenty-two windows. Her goitre was large and contained an unusual combination of soft cellular and firm fibrous material.

Case No. 58 has carried on a life of unusual intellectual activity as a writer during the eight years which have elapsed since her operation, although she has suffered from a broken hip with its necessary confinement during that period. Her operation was for cystic adenoma of fifteen years' duration and two years' rapid growth. At the time of her operation her pulse was 120 and she suffered from palpitation, tremor and perspiration.

Case No. 12, fifteen years after an operation, "tends store all day, beginning at 6.30 A.M., and does the house work for herself and mother before and after these duties." Her operation was for a very large adenoma of fifteen years' duration and two years' rapid growth, severe pressure symptoms and moderate constitutional disturbance.

These facts are given in detail in an effort to show to others the impression which we have received on studying these patients. This group has impressed the writer as showing more than the average degree of good health and capability. All of them were incapacitated before operation—most of them from "toxic" symptoms—a few of them from pressure symptoms. Their study indicates a remarkable average of good health after previous disabilities which had been disturbing in a high degree.

It should be stated that in no instance has operation been done for the simple goitre of adolescence or for any other form of simple goitre which did not give definitely disturbing symptoms.

Of late much attention has been given to the query as to how patients with goitre will do without operation or even without treatment.

The histories of some of the patients mentioned in Groups 1, 2 and 3 indicate the condition to which such patients may drift. Two other experiences which throw light on the subject also come to mind. One, a woman of fifty-eight, who had had a goitre for thirty years. Her pulse had frequently been rapid and she had frequently been obliged to stop her labors at housework, but she would always resume them again as soon as the acute attack had passed away. When I saw her she had acute pain in the epigastrium. Her heart was dilated, very irregular and gave beats from 160 to 180 per minute. It was of extremely poor quality and made any operative procedure out of the question. She was very thin and had a large goitre most marked on the right side of her neck and apparently cystic there. This was an example of chronic goitre which had finally resulted in cardiac failure. She died on the following day. The other, a man of forty years, who had lived in the Middle West and had been suffering from the symptoms of acute thyroid disease for three months. He had lost 20 pounds, was weak and had to give up work. He had a severe tremor and rapid pulse and was very nervous. His goitre was soft and of moderate size. He was taken to the hospital for a more thorough examination, but became restless after two days and returned home. His weakness then increased and he died within a few days. All surgeons who see many goitres have similar experiences and are forcibly impressed with the seriousness of the disease in both its chronic and acute forms.

When such cases are contrasted with the results which have followed the operations in this group, one must feel like attacking the disease in a radical manner.

Cancer or Suspected Cancer.—The pathology of the thyroid is complex. It brings puzzling problems to both pathologists and clinicians. The most remarkable instance in this group occurred in a man of forty-eight, who for a year had suffered from a left-sided goitre, with both constitutional and pressure symptoms. An encapsulated cystic tumor 9 x 7 x 5 cms. in its diameters was enucleated from the left lobe of the thyroid. None of the adjoining tissue was removed. Since there was no apparent extension of the growth beyond its capsule and since its enucleation was easy, malignancy was not clinically thought of. However, three well-known pathologists agree in the diagnosis of "adenocarcinoma, probably of low malignancy." At the present time, three and one-fourth years after the operation, the patient is free from recurrence and is enjoying excellent health. Another patient who had a papillary cyst adenoma has now been followed for nine years. He is entirely free from symptoms and is actively engaged in business. He had rapid recurrences after his first partial operations and finally every discoverable bit

of thyroid gland was removed and radium was left in the wound for a few hours, in the endeavor to control any fragment which might possibly remain. There was also much pathological and clinical consultation about this case and bad prognoses were generally given. There were two other papillary cyst adenomas in the group, but there was no recurrence or suggestion of malignancy in either of them. Another tumor which clinically suggested a progressing neoplasm was reported "lympho-granuloma of thyroid." The patient made an excellent recovery after its removal, and now in her fifth post-operative year shows no suggestion of recurrence. These cases are mentioned to show the uncertainties of thyroid pathology.

The relationship of the X-ray to the thyroid gland should also be considered. A number of cases here recorded had received X-ray treatment before coming for surgery. It is not now possible to say how many. Some of the cases mentioned in Divisions 2 and 3, also received X-ray treatment after leaving the hospital. I have treated at least four patients by X-ray without operation. Two of them were very mild cases and have done well. A third case was toxic; when first treated had a marked tremor, basal metabolism plus 35, with a very small thyroid. He did well under X-ray. Another one with a large adenoma and very mild toxic symptoms preferred X-ray treatment to operation and now after the lapse of a year is in about the same condition as when first seen.

It is notable that experienced röntgenologists consider hyperplastic thyroids the most suitable type for X-ray treatment and that many failures of relief come after X-ray treatment of such goitres, also it is notable that adenomata which are not so well suited for X-ray treatment produce some of the most disturbing symptoms and respond particularly well to surgery.

The results of ligation of the thyroid arteries have been interesting. Preliminary ligation of the superior poles of the thyroid gland, including the arteries, has been a common procedure in patients too ill for more extensive primary operation. Definite improvement almost always follows this procedure, so that after two or three months a suitable portion of the gland may be removed. These patients, however, are not always easily controlled and sometimes cannot be persuaded to submit to the secondary operation. Cases already quoted in groups 1 and 2 show the unfortunate condition into which such patients may drift. One patient, however, did so well after double superior pole ligation that secondary operation was not advised; and now, after the lapse of eleven years, is in excellent condition. She was a young woman of twenty-four with a short history of acute hyperthyroidism.

There are two notable results following quadruple ligation, one a patient of thirty-eight years had severe toxic symptom of five months' duration. She had a rather large symmetrical goitre, exophthalmus, tremor, pulse 120 to 150, and was too weak to work. The superior arteries were ligated in June, 1919, and the inferior arteries in February, 1920—she made a remarkable recovery and has now been working successfully as laundress for more than three years. Another young woman whose symptoms were complex, but who

had exophthalmus—moderate-sized goitre, rapid pulse, "nervousness," inability to work and basal metabolism plus 17, recovered her poise after quadruple ligation and at the present time, three years after her first ligation, is successfully conducting a boarding house.

Operation on patients under the age of twenty-one is not often desirable. The goitre of adolescence frequently subsides without operation. There are two rare exceptions to this rule: first, the young patient who develops extremely toxic symptoms—"true exophthalmic goitre"; second, the young person who develops an adenoma so large as to give pressure symptoms or real disfigurement. An instance of the latter condition may be referred to. Case No. 16 came to me in 1909 when twenty years of age, having a goitre which had been present twelve years. It was very large and was giving great disfigurement and some pressure symptoms. I removed a large part of it and found it to be an adenoma with cystic formation in some parts. On seeing her fourteen years later, I find her in excellent health. She has had seven children in the meantime and her goitre has returned. Her neck is now the site of a large cystic goitre which is similar to the one which was removed fourteen years ago. However, it is soft and does not give pressure symptoms.

There have been a few other adenomas in young girls which have developed to considerable size and have given definite pressure symptoms. These have been removed with good results.

The seriousness of long persisting adenomas and the favorable result of operation may be illustrated by the following case: A patient of forty-five years, with a moderate-sized goitre, came to the hospital with a six-year history of disability, having had remissions and exacerbations, but having endeavored to carry on her ordinary duties during most of the period. She has recently shown lack of strength, tachycardia, tremor, nervousness, perspiration, and was unable to work. On admission to the hospital her disability was extreme. Perspiration and weakness and nervousness were excessive. Basal metabolism was +83. She manifestly was not in condition for surgical procedure. She went to an endowed room in the Medical Division for five weeks where Doctor Sumner kindly attended to her treatment. She showed considerable improvement, her basal metabolism went down to + 30 and then went to +40. Her heart was dilated and rapid and irregular, pulse being 110 to 120. She gave definite evidence of degeneration of the cardiac muscle. However, since the thyroid nodule was apparently encapsulated and since she had ceased to improve under medical treatment, I removed the nodule by a very short operation and she made a remarkably satisfactory recovery, pulse coming down to 64, basal metabolism reaching normal and her entire mental attitude being satisfactory. Her strength improved and she was able to return to her ordinary duties.

Recurrences.—In one instance (just referred to) there has been a recurrence of an adenoma which has reached a large size. In seven other instances there have been moderate recurrences of adenomas, none of them serious.

Hypothyroidism has not been observed in any of the patients.

SUMMARY

1. The results of treatment on these 150 patients may be tabulated as follows:

	Number of patients	Percentage of those patients who were traced after leaving hospital	Percentage of entire group
a. Enjoying good health and able to do at least the ordinary amount of work	103	73.6	68.66
b. Able to enjoy life and do moderate work but carefully avoiding over-exertion	32	22.8	21.33
c. Persistent invalidism	1	0.7	.66
d. Died since leaving hospital	4	2.9	2.66
e. Died in hospital	5		3.33
f. Not traced	5		3.33
Total	150		

2. The operations have been adjusted to meet the strength of the patient, sometimes beginning with the ligation of a single thyroid artery and progressing in stages to the removal of three-quarters or more of the enlarged gland.

3. Acute hyperplastic thyroids have given the most severe symptoms but toxic adenomas have sometimes been almost as serious.

4. Adenomas and so-called colloid goitres have sometimes given distressing symptoms from pressure and unsightliness.

5. Some patients have improved under rest and medicinal treatment and the use of the X-ray, but so many failures have been noted in these forms of treatment that operation is believed to be the best form of treatment for a very large proportion of patients with goitre.

6. The pathology of cancer and growths which resemble cancer is very complex.

A REPORT OF 87 PRIMARY OPERABLE CASES OF CARCINOMA OF THE BREAST ADMITTED TO THE NEW YORK HOSPITAL PRIOR TO APRIL 1, 1919

By Burton J. Lee, M.D.

and

Nelson W. Cornell, M.D.

of New York, N.Y.

The literature of mammary cancer contains many reports of high percentages of good end results, in the surgical treatment of this disease. A careful scrutiny of these records sometimes reveals the fact that many recent cases are included, making a proper estimate of the operative results difficult and at times impossible. The object of this paper is to place on record the late results in a series of cases of carcinoma of the breast operated at the New York Hospital,† prior to April 1, 1919, five years or more ago. All cases of more recent date are excluded from consideration. A still more dependable period for end results is seven or ten years, but sufficient cases are not available to make a report upon this basis. We appreciate that the group is a small one, but we feel that a critical analysis of these cases may furnish some valuable conclusions.

At the very outset we wish to place ourselves on record as objecting to the continued use of the term "three-year cure," the basis of our objection being twofold. First, any serious consideration of results in the treatment of breast cancer at the end of three years is ill-advised, for the three-year limit gives a poor impression of what the end result will be. Second, we desire to protest against the continued use of the term "cured," in recording the results of the treatment of this disease by any means. We are all familiar with the occasional cases of late recurrence, occurring many years after the surgical treatment of carcinoma of the breast, and therefore we believe that the word "cured" should be abandoned and replaced by the phrase "no evidence of disease to date."

Our study embraces only primary cases which were presumably operable and were subjected to surgery in the hope of eradicating the disease. In general, the criteria of operability were a tumor in the breast, not fixed to the chest wall, with or without involved axillary nodes. The presence of supraclavicular nodes placed the case in the inoperable group, and no patient was subjected to a supraclavicular dissection. This judgment concerning the

* Read before the American Surgical Association, April 18, 1924.

† The writers gratefully acknowledge the privilege accorded them by Dr. Chas. L. Gibson and Dr. Eugene H. Pool, of recording the cases of mammary cancer from the First and Second Surgical Divisions of the Hospital. They also appreciate similar courtesies extended by other surgeons on these Services.

he is forced to the conclusion that many factors must be considered in evaluating the reported results. These factors are:

1. The pathological diagnosis of carcinoma may vary widely in different clinics. If one includes in his carcinoma series border line cases of epithelial growth (so-called pre-cancerous lesions), the figures for good end results will be raised to a very high percentage. As far back as 1907, Halsted pointed out that some pathologists might include "a few epithelial cells here and there escaping into the stroma as carcinoma." Are the cases of so-called "microscopic cancer," which Rodman says he finds in 23 per cent. of the cases of chronic cystic mastitis, to be included in reports of end results of the treatment of mammary cancer? We feel that the surgeon is too prone to accept as truth typewritten pathological reports made by pathologists, some of whom may lack the highest technical training. One of the writers has received pathological reports from one New York hospital upon five breast cases showing definite recurrent phases of mammary cancer, the report in all five instances being incorrectly rendered "fibroadenoma."

FIG. 2.—Radiograph of early chest metastasis.

2. Many writers apparently include a certain proportion of recent cases which swells percentage figures. We have found it difficult to separate out the results in recent cases from those operated five years or more ago.

3. Many of the cases have not been completely followed up. Until the last decade, adequate follow-up systems were not a part of any hospital organization, and vast numbers of cases operated upon for this disease were completely lost track of. Therefore, it was quite impossible for most surgeons to evaluate the real end results in the surgical treatment of cancer of the breast.

4. In many reports a large number of cases are excluded which have been lost sight of, many of whom are probably dead.

The present paper is a study of eighty-seven presumably primary operable

involvement of supraclavicular nodes is concurred in by Peck and Sutton and Rodman and Greenough have stated that no satisfactory end result has been attained where supraclavicular nodes were involved at the time of operation. We are so convinced that supraclavicular metastasis is an expression of a considerable dissemination of the disease, that to-day we call cases inoperable that show definite and well-marked supraclavicular fulness, even though no palpable nodes are present. Experience has taught us that such cases invariably develop nodes which are palpable a few weeks or months later. The criteria of operability of mammary carcinoma are changing, and cases to-day are subjected to a much more careful scrutiny than was the case ten years ago. Therefore, it is probable that some of the patients included in this report and treated as primary operable carcinomas of the breast might to-day be placed in the inoperable class. The writers feel that the presence of axillary nodes, which are obviously extensively involved, reaching well up to the clavicle, or which are fixed to the chest wall, indicates inoperability. Further, a more searching study of a case with special regard to the paths and symptoms of distant metastases, especially to the chest and bones, will sometimes reveal evidence eliminating the patient from the operable class. A summary of the factors placing a case in the inoperable group has been indicated in a recent communication of one of the writers. We have not included in this study any of the primary inoperable or recurrent cases admitted to the hospital in the period mentioned, as we believe they must be considered separately. Further, the end results in these groups have no relation to the problem of the treatment of primary operable mammary cancer by surgery.

FIG. 1.—Rapid metastasis after operation for mammary carcinoma associated with seven months' pregnancy.

If one weaves his way through the mass of literature upon this subject, he will find a varied series of figures of so-called "cures," in percentages varying from 22 per cent. to 46 per cent. As one studies these statistics,

cases, seventy-five of whom have been followed through sufficiently to furnish accurate data concerning the five-year results obtained. Of the seventy-five cases, the following tabulation is made:

Results to Date in 75 Primary Operable Carcinomas of the Breast

Alive and with no evidence of recurrence	10
Died without recurrence more than 5 years after operation	1
Died with recurrence	54
Recurrence, but not completely traced	10
	75

Following on p. 404 is a detailed list of the 75 patients.

Twelve cases are excluded from major consideration because of inconclusive data as to end results, but these patients are separately studied in conjunction with the 75 complete cases in tabulating certain etiological data. These 12 patients group themselves into two classes: namely, those dying before five years had elapsed without recurrence, but from intercurrent disease, and secondly, those which were impossible to trace, although not recurrent when last observed. A brief tabulation of these twelve cases is appended.

A study of the 87 cases yields certain facts concerning the influence of trauma, previous abscess in the breast and prior lactation, in connection with the etiology of mammary cancer.

Trauma.—Of the entire 87 cases a positive or negative statement concerning a definite history of trauma was made by 55 patients. In each instance a positive statement by the patient was considered reasonably reliable evidence.

Trauma as an Etiological Factor.—Positive 15, 27 per cent.; negative 40, 73 per cent.

The traumatizing agent varied from blows or falls upon the breast to corset pressure, and one patient made the statement that she had been accustomed for years to stick pins into the portion of the breast which subsequently became the seat of cancerous disease.

Types of Trauma.—Blow or fall upon breast, 11; corset pressure, 2; bullet wound, 1; habit of sticking pins in breast, 1. Total, 15.

Previous Abscess of the Breast.—Five cases had previously suffered from abscess of the breast. There seems little question that the damage done to mammary tissue in the presence of a suppurative process furnishes favorable soil for the development of carcinoma.

Prior Lactation.—We are more and more impressed with the frequency of occurrence of cancer in breasts that have never lactated. In this series no statement concerning previous lactation was made in 15 instances. Of the remaining 72 patients, exactly one-half had a history of previous lactation. It seems reasonable to conclude that prior lactation is not an important factor in the development of mammary cancer. Positive 36, 50 per cent.; negative 36, 50 per cent.

Situation of the Tumor.—In 81 cases, the record shows that the left breast was involved in 43 instances and the right breast in 38.

TABLE I

No.	Surgeon	Year	Name	Age	Duration Before Operation	Duration After Operation	Total duration	Result	Pathology	Date metastasis	Metastasis
1	Hitzrot	1912	S.	45	2 yrs.	2½ yrs.	4 yrs., 6 mos.	Died	Scirrhus	6 mos.	Opp. breast, spine.
2	Lee	1913	C.	26	5 mos.	11 mos.	1 yr., 4 mos.	Died	Duct ca.	4 mos.	Opp. breast chest, supra. axilla.
3	Lee	1913	H.	50	6 mos.	3 mos.	9 mos.	Died	Scirrhus	3 mos.	Spine.
4	Gibson	1913	L.	34	8 mos.	5 mos.	1 yr., 1 mo.	Died	Ca. very malignant	2 mos.	?
5	Gibson	1913	M.	52	7 mos.	2 yrs., 8 mos.	3 yrs., 3 mos.	Died	Scirrhus	?	?
6	Gibson	1913	V.	58	1 yr.	10 yrs., 5 mos.	11 yrs., 5 mos.	A. W.*	Scirrhus	.....	.....
7	Lee	1913	C.	49	1 yr., 6 mos.	9 mos.	2 yrs., 3 mos.	Died	Scirrhus	2 mos.	Chest, supra-clavicular.
8	Farr	1913	K.	49	.....	.....	.....	A. W.	Ca.	.....	.....
9	Gibson	1913	L.	41	.....	.....	.....	Died	Med. Ca.	14 mos.	Sternum.
10	Lee	1914	K.	45	1 yr., 6 mos.	5 yrs., 9 mos.	7 yrs., 3 mos.	Died	Scirrhus	.....	Without recurrence.
11	Lee	1914	M.	53	5 mos.	1 yr., 8 mos.	2 yrs., 1 mo.	Died	Scirrhus	1 yr., 6 mos.	Chest wall.
12	Lee	1914	H.	48	5 yrs.	2 yrs., 2 mos.	7 yrs., 2 mos.	Died	Scirrhus	2 yrs.	Spine.
13	Gibson	1914	C.	57	.....	.....	.....	A. W.	Scirrhus	.....	.....
14	Gibson	1914	S.	50	6 mos.	1 yr., 6 mos.	2 yrs.	Died	Ca.	1 yr., 3 mos.	Upper axilla, supra. nodes.
15	Hitzrot	1914	N.	47	2 yrs.	5 yrs., 4 mos.	7 yrs., 5 mos.	Died	Ca.	4 yrs., 6 mos.	Rt. supra., chest.
16	Lee	1915	M.	46	1 yr.	1 yr., 1 mo.	2 yrs., 1 mo.	Died	Duct. ca.	3 mos.	Cervical nodes.
17	Gibson	1915	O.	46	5 yrs.	9 yrs.	14 yrs.	A. W.	Ca.	.....	.....
18	Lee	1915	G.	60	8 mos.	4 yrs., 5 mos.	5 yrs., 1 mo.	Died	Ca.	?	Supraclav. nodes.
19	Hitzrot	1915	S.	51	2 yrs.	11 mos.	2 yrs., 11 mos.	Died	Simplex	4 mos.	Scalp.
20	Farr	1915	A.	47	8 mos.	1 yr.	1 yr., 8 mos.	Died	Medull. ca.	10 mos.	Chest wall.

21	Lee	1915	Y.	45	6 mos.	5 yrs., 6 mos.	6 yrs.	Died	Ca.	5 yrs.	Supraclav. lumbar spine.
22	Lee	1915	O.	43	1 yr.	5 yrs., 7 mos.	6 yrs., 7 mos.	Died	Ca.	5 yrs.	Spine.
23	Lee	1915	F.	46	8 mos.	5 yrs., 10 mos.	6 yrs., 6 mos.	Died	Large absc.	2 yrs.	Spine.
24	Turune	1915	C.	38	7 mos.	18 mos.	2 yrs., 3 mos.	Recur.	Ca.	6 mos.	Chest wall incomplete.
25	Bancroft	1915	S.	28	9 mos.	1 yr.	1 yr., 9 mos.	Died	Scirrhus	7 mos.	Supraclav.
26	Bancroft	1915	S.	41	9 yrs.	7 yrs., 6 mos.	16 yrs., 1 mo.	Died	Scirrhus	22 mos.	Supraclav.
27	Pool	1915	P.	51	4 yrs.	6 mos.	4 yrs., 6 mos.	Died	Ca.	4 mos.	Supraclav.
28	Lee	1916	E.	39	6 mos.	7 yrs., 5 mos.	7 yrs., 11 mos.	A. W.	Adeno-ca.	.....	.....
29	Lee	1916	C.	40	1 yr.	2 yrs., 9 mos.	3 yrs., 9 mos.	Died	Scirrhus	9 mos.	Same breast.
30	Pool	1916	S.	53	4 yrs.	1 yr., 6 mos.	5 yrs., 6 mos.	Died	Ca.	few mos.	Supra. nodes later gen. metastases.
31	Hitzrot	1916	G.	40	11 mos.	6 yrs.	6 yrs., 11 mos.	Died	Ca.	3 yrs.	Skin, chest.
32	Bancroft	1916	B.	41	1 yr., 6 mos.	1 mo.	?	Recurrent	Ca.	1 mo.	Supraclav. nodes.
33	Erdman	1916	Y.	60	4 mos.	6 mos.	10 mos.	Died	Fib. ad. ca.	3 mos.	Supraclav. nodes.
34	Bancroft	1916	G.	16	4 yrs.	8 yrs.	12 yrs.	A. W.	Fib. ad. ca.	.....	.....
35	Erdman	1916	P.	47	6 mos.	8 mos.	1 yr., 2 mos.	Died	Ca.	?	Axilla, general metastasis.
36	Pool	1916	P.	67	1 yr.	3 yrs., 6 mos.	4 yrs., 6 mos.	Died	Scirrhus	.....	Lung metastasis.
37	Gibson	1916	F.	63	1 wk.	5 yrs., 1 mo.	5 yrs., 1 mo.	Died	Ca.	3 yrs., 1 mo.	Opp. breast and axilla amputation.
38	Lee	1916	N.	49	2 mos.	7 yrs., 4 mos.	7 yrs., 6 mos.	Died	Ca.	6 mos.	
39	Lee	1916	M.	54	2 wks.	1 yr., 5 mos.	1 yr., 5 mos.	Died	Ca.	6 mos.	Scar. Later gen. metastasis.
40	Gibson	1916	J.	60	2 yrs.	?	?	Recur.	Scirrhus ca.	5 yrs., 7 mos.	Axilla (could not complete).
41	Gibson	1916	F.	55	2 wks.	2 yrs. 1 mo.	2 yrs., 1 mo.	Died	Scirrhus ca.	2 yrs.	Spine.
42	Gibson	1916	D.	78	6 mos.	4 yrs., 3 mos.	4 yrs., 9 mos.	Died	Scirrhus ca.	4 yrs.	Gen. ca.

*A. W., Alive and well.

TABLE I.—*Continued.*

No.	Surgeon	Year	Name	Age	Duration Before Operation	Duration After Operation	Total duration	Result	Pathology	Date metastasis	Metastasis
43	Farr	1916	R.	36	9 mos.	1 yr., 7 mos.	2 yrs., 4 mos.	Died	Ca.	1 yr., 5 mos.	Same breast neck.
44	Hitzrot	1916	S.	53	10 days.	2 yrs., 6 mos.	2 yrs., 6 mos.	Died	Ca.	1 yr., 11 mos.	Chest, abdomen.
45	Farr	1916	S.	35	10 days.	7 yrs.	7 yrs.	A. W.	Scirrhus ca.	.....	.....
46	Hitzrot	1916	M.	39	1 yr.	1 yr., 2 mos.	2 yrs., 2 mos.	Died	Scirrhus ca.	7 mos.	Bones.
47	Farr	1917	W.	28	2 mos.	1 yr., 1 mo.	?	Recur.	Ca.	1 yr., 1 mo.	Line incision, L. axilla.
48	Gibson	1917	B.	60	6 mos.	2 yrs., 5 mos.	2 yrs., 6 mos.	Died	Ca.	.....	.....
49	Bancroft	1917	S.	40	4 mos.	3 yrs., 7 mos.	3 yrs., 11 mos.	Recur.	Gelatinous ca. ✓	3 yrs., 7 mos.	5–6 costal cartilages.
50	Gibson	1917	H.	52	1 wk.	4 yrs., 9 mos.	4 yrs., 9 mos.	Died	Ca.	4 yrs.	Brain, tibia.
51	Lee	1917	R.	35	1 yr.	10 mos.	1 yr., 10 mos.	Died	Ca.	6 mos.	Axilla, breast and axilla.
52	Farr	1917	M.	40	10 mos.	11 mos.	1 yr., 9 mos.	Died	Ca.	8 mos.	Local.
53	Hitzrot	1917	B.	56	2 mos.	1 yr.	1 yr., 2 mos.	Recur.	Scirrhus ca.	9 mos.	Uterus, omentum.
54	Gibson	1917	M.	62	3 yrs.	4 mos.	3 yrs., 4 mos.	Died	Scirrhus ca.	?	?
55	Lee	1917	M.	63	2 wks.	3 yrs., 4 mos.	3 yrs., 4 mos.	Died	Scirrhus ca.	3 yrs., 4 mos.	Abdomen.
56	Lee	1917	K.	70	9 mos.	1 yr., 4 mos.	2 yrs., 1 mo.	Died	Scirrhus ca.	8 mos.	Supraclavicular.
57	Farr	1917	L.	37	5 mos.	5 mos. 4 mos.	10 mos.	Died	Scirrhus ca.	2 mos.	Abdomen.
58	Gibson	1917	C.	43	?	4 yrs., 3 mos.	?	Died	Ca.	?	Spine, axilla.
59	Bancroft	1917	D.	30	3½ mos.	3 yrs.	3 yrs., 3½ mos.	Died	Fibro-ca.	2 yrs., 8 mos.	Spine.
60	Vietor	1917	L.	45	5 wks.	2 yrs.	2 yrs., 1 mo.	Recur.	Ca.	1 yr.	Sternu.
61	Farr	1918	B.	43	1 yr., 6 mos.	3 yrs., 2 mos.	4 yrs., 8 mos.	Died	Scirrhus ca.	3 yrs.	Brain, lung.

62	Gibson.....	1918	O.	54	3 mos.	2 yrs., 9 mos.	3 yrs.	Died	Fibro-ca.	2 yrs., 10 mos.	Same axilla.
63	Gibson.....	1918	H.	59	7 mos.	1 yr., 3 mos,	1 yr. 10 mos.	Died	Adeno-ca.	8 mos.	Intra-abdominal.
64	Gibson.....	1918	H.	53	1 yr., 6 mos.	4 yrs., 8 mos.	6 yrs., 2 mos.	Recur.	Sm. abscess	4 yrs.	Supracl. and ax. nodes.
65	Farr.....	1918	S.	36	1 mo.	6 mos.	7 mos.	Died	Adeno-ca.	2 mos.	R. breast, lung, liver spine.
66	Gibson.....	1918	M.	58	?	2 yrs. 6 mos.	?	Recur.	Fibro-ca.	2 yrs. 6 mos	Skin.
67	Hitzrot.....	1918	C.	45	1 yr.	3 yrs., 6 mos.	4 yrs., 6 mos.	Died	Fibro-ca.	2 yrs., 5 mos.	Skin, lungs, ribs.
68	Hitzrot.....	1918	N.	54	1½ yrs.	4 yrs., 4 mos.	5 yrs., 10 mos.	Died	Scirrhus ca.	4 yrs.	Chest.
69	Bancroft.....	1918	B.	60	3 wks.	5 yrs., 6 mos.	5 yrs., 7 mos.	A. W.	Scirrhus	.....	.....
70	Erdman.....	1918	C.	43	7 mos.	5 yrs., 10 mos.	6 yrs., 5 mos.	Recur.	Fibro-ca.	3 yrs., 6 mos.	Right axilla.
71	Vietor.....	1918	H.	44	1 yr.	8 mos.	1 yr. 8 mos.	Died	Large abscess	5 mos.	Liver.
72	Hawkes.....	1918	T.	41	1 yr.	8 mos.	1 yr., 8 mos.	Died	Small abscess	few mos.	Gen. metastasis.
73	Vietor.....	1918	S.	40	3–4 mos.	5 yrs.	5 yrs., 4 mos.	A. W.	Ca.	.....	.....
74	Hawkes.....	1919	F.	60	3 mos.	5 yrs., 1 mo.	5 yrs., 4 mos.	A. W.	Adeno-ca.	.....	....
75	Gibson.....	1919	A.	68	2 mos.	2 yrs., 7 mos.	2 yrs., 9 mos.	Died	Med. ca.	2 yrs., 10 mos.	Site operation.

TABLE II

Died Before 5 Years Post Operation Without Recurrence.

No.	Surgeon	Year	Name	Age	Duration Before Operation	Duration After Operation	Total duration	Result	Pathology	Date metastasis	Metastasis
76	Bancroft.....	1917	B.	38	8 days.	1 mo., 4 days.	2 mos.	Died	Ca.	1 mo.	Same side.
77	Bancroft.....	1918	L.	56	5 wks.	11 days.	6 wks.	Died	Ca.	11th post-op. day. Lobar pneumonia.	
78	Erdman.....	1918	T.	46	2 mos.	1 yr., 6 mos.	1 yr., 8 mos.	Died	Fibro-ca.	Insane. Died Ward's Is.—No recurrence.	
79	Erdman.....	1918	U.	51	6 wks.	2½ wks.	8 wks.	Died	Comedo-ca.	Pneumonia, 6 days after leaving hosp.	
80	Gibson.....	1919	W.	33	?	?	?	Died	Ca.	Insane, shortly after discharge. No recurrence.	

TABLE III

Inconclusive—Not Followed—Not Recurrent When last Seen.

No.	Surgeon	Year	Name	Age	Duration Before Operation	Duration After Operation	Total duration	Result	Pathology	
81	Gibson.....	1913	D.	44	1 mo.	1 yr., 7 mos.	?	?	Ca.	Lost track of.
82	Lee.....	1914	M.	45	1 yr.	2 yrs., 9 mos.	?	?	Ca.	Lost track of.
83	Lee.....	1914	M.	38	1 yr.	.....	..	..	Adeno-ca.	
84	Lee.....	1915	Z.	66	8 mos.	2 yrs., 4 mos.	?	?	Ca.	Lost track of.
85	Lee.....	1916	F.	40	1 yr.	1 yr.	?	?	Pap. cyst	
86	Hitzrot.....	1917	C.	50	1 yr., 6 mos.	1 yr., 3 mos.	?	?	Ca.	Lost track of.
87	Gibson.....	1918	M.	42	.....	2 yrs., 2 mos.	..	..	Fibro-ca.	Lost track of.

A description of the portion of the breast involved is given in 69 instances. The following table indicates the location of the tumor: Upper outer quadrant, 33; lower outer quadrant, 12; outer half, 8; mesial above nipple, 8; upper inner quadrant, 4; lower inner quadrant, 3; upper half, 1. Total, 69.

Correct Pre-operative Diagnosis of Carcinoma of the Breast.—A record of the pre-operative diagnosis was recorded in all instances. Percentage of correct diagnosis is as follows: Number of cases correct 81, 93 per cent.; number of cases incorrect 6, 7 per cent. All surgeons appreciate the difficulty in making a correct diagnosis in every instance. The percentage given above is practically identical with that reported by Mills and Greenough and Simmons, the former giving 93 per cent. and the latter 94 per cent.

FIG. 3.—Radiograph of early chest metastasis.

Pre-operative Diagnosis of Involved Axillary Nodes.—In four instances no statement was made as to the pre-operative impression of metastasis to the axilla. In 83 patients definite statements are recorded, giving the pre-operative diagnosis of the surgeon as to the involvement of axillary nodes. Believed to be positive 59; correct 49, 83 per cent. Believed to be negative 24; correct 19, 79 per cent. Total, 83.

This tabulation illustrates the difficulty of correctly diagnosing involvement of axillary nodes. The experience is universal to occasionally encounter considerable axillary metastasis where none was anticipated, and vice versa, to find hyperplastic lymph-nodes free from cancerous disease where definite malignancy was expected. Although deductions from a small group of cases are always dangerous, the table shows a lessened liability of error where the surgeon believes the nodes to be definitely involved.

Factors Influencing Prognosis.—Various factors must be considered in reaching a correct prognosis in any case of cancer of the breast. Each patient represents a complex problem due to the variable conditions afforded by age, the rapidity of growth, associated pregnancy, the pathological type of

tumor, the presence or absence of involved axillary nodes, the proper interpretation of the signs of early chest metastasis and of early metastasis to bone. We will briefly consider each of these factors.

Age.—Of the 75 cases completely followed, we have divided them into three age groups, namely:

TABLE IV

		Number	Number alive	Per cent. alive
I.	Up to and including 50 years of age	19	4	21%
II.	41 to and including 60 years of age	49	7	14%
III.	61 years and over	7	0	0%
		75		

1. *Patients up to and Including Forty Years of Age.*—All authorities agree that other things being equal the younger the patient the more serious the outlook. In the present series the percentage in this age group alive and without disease five years or more after operation (21 per cent.) is distinctly higher than the average for the entire group. The reason for this high percentage in the younger women can be explained, partially at least, by the fact that all of the four living cases in this group were distinctly localized tumors without metastasis to the axilla. Further, Case No. 34 presented some very unusual pathological features, which will be discussed under the section on pathology, making it perhaps questionable whether this case should be included at all in the present study. If this case were excluded, the percentage alive would be 16 per cent. rather than 21 per cent. The small number of cases available for study in this age group makes any percentage figure inconclusive.

2. *Patients from Forty-one to and Including Sixty Years of Age.*—We feel that no special comment upon this group is necessary other than to call attention to the fact that it represents the approximate cross-section of percentage results five years after surgical treatment of the disease.

3. *Patients Sixty-one Years of Age and Over.*—Experience has generally proven that patients in this group, as a rule, do well following surgical intervention. Usually the rate of growth is slow, and the patients are apt to live many years following operation before menacing metastases occur. The group of seven cases is much too small from which to draw any conclusive deductions, but it perhaps illustrates that this group may not be as favorable as we have generally believed it to be.

Rapidity of Growth.—In general, a convincing statement by the patient that the growth of the tumor has been exceedingly rapid, should lead the surgeon away from rather than toward surgical intervention. We have frequently heard surgeons express the opinion that immediate radical operation should be undertaken, because the growth has been at such a startling rate. Such an attitude we believe to be an incorrect one, as the prognosis of these rapid cases, treated by radical surgery, is always bad, and we believe many of them would survive the disease longer if some other form of therapy were followed. If the growth is rapid and the woman is below forty, in general

we feel that operation is unwise. Practically without exception the rapidly growing tumors in the present series have succumbed to the disease within a few months up to two years of the date of operation.

Associated Pregnancy.—We are all thoroughly familiar with the extreme gravity of the prognosis in a case of carcinoma of the breast associated with pregnancy. These patients are usually young women, which adds further to the seriousness of the prognosis. In our series one patient (Case No. 2), twenty-six years of age, was seven months pregnant at the time of her admission to the hospital. Radical operation was advised and done by one of the writers with a rapidly disastrous result, the patient surviving the surgical intervention by but eleven months. The result in this case represents a judgment against the over-enthusiasm of youth. To-day no such management of the situation would for a moment be entertained. The almost immediate recurrence with the rapid extension of the disease was frightful. This patient finally died in the hospital with a huge massive involvement of the whole chest wall, extensive adjacent metastasis to the lung and pleura and ended with an opening several inches across, entering the chest cavity.

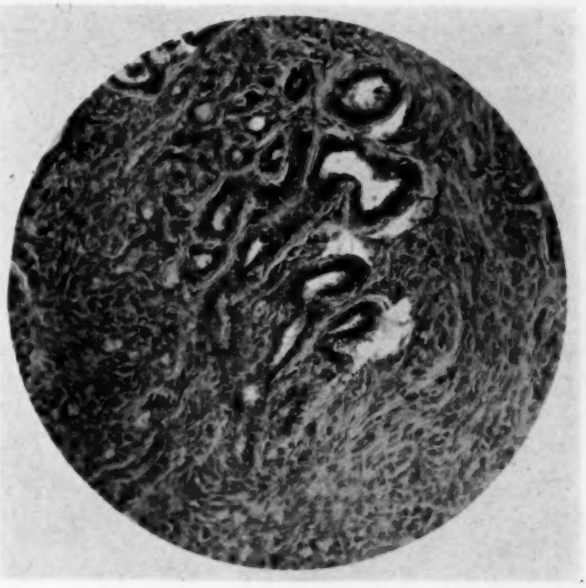


FIG. 4.—Low power photomicrograph of Case No. 34, fibro-adeno-carcinoma, questionable malignancy.

The presence of a lactating breast associated with carcinoma is far less menacing to the patient than pregnancy. Three patients in this report were nursing children at the time of the breast amputation. Case No. 24 developed a recurrence in six months and died eighteen months post-operative, with extensive chest metastasis. Cases Nos. 59 and 70 also recurred, the first two years and eight months, and the latter three years and six months after operation. Pathological report in each instance was a fibro-carcinoma, which probably accounts partially for the delay in recurrence. Further, Case No. 70 received considerable prophylactic X-ray treatment over a period of two and a half years, which probably helped to delay the date of recurrence and the rate of growth of the tumor process.

Pathological Types.—Sistrunk and MacCarty and many others have pointed out the wide variations in pathological types of mammary cancer as to

the degree of malignancy. We are convinced that the term "carcinoma of the breast" in reality covers a group of diseases presenting widely different clinical courses and frequently distinctive pathological pictures. We believe that as more accurate knowledge of these pathological groups is obtained, the results of the treatment of cancer of the breast can be much better standardized. At the present time we are convinced that many cases are placed in the carcinoma group which really do not belong there. It is often difficult to properly interpret a pathological picture even when the interpretation is made by pathologists of the front rank. Case No. 34, in this present series, illustrates the difficulty in question. This young woman, sixteen years of age, was operated upon for what was believed to be a fibro-adenoma. A local removal of the tumor was practiced and upon the basis of the pathological examination by Elser, corroborated by Ewing, a local mastectomy was performed. A diagnosis of fibro-adeno-carcinoma was rendered, but in the experience of both of these pathologists the tumor is quite unique. Sections of the tumor show nodules composed of a cellular epithelial growth which in part is of glandular type. These nodules are sharply defined by an unbroken limiting membrane. The surrounding fibrous tissue shows considerable overgrowth, with some disorder in arrangement. More recently in reviewing this slide, both Elser and Ewing expressed grave doubt whether or not one should include such a case in a group of cases of mammary carcinoma. If a more systematic effort were made to gather together unusual cases of this and other types, we feel that it might ultimately be possible to separate out cases of this sort from the cancer group.

The following table is appended setting forth the number of cases of each pathological group encountered in this series. Although a pathological report was rendered in each instance, in 27 cases the diagnosis of "carcinoma" only was made. The percentages of each pathological type in the 48 remaining cases is given. The percentage alive for each group is also added in a separate column.

TABLE V

Pathological Types

	Number.	Per cent.	Number alive 5 years without recurrence.	Per cent. of group alive.
Scirrhus ca	26	54	5	19
Fibro ca	5	10	0	0
Adeno ca	4	8	2	5
Alveolar ca	4	8	0	0
Medullary ca	3	6	0	0
Fibro adeno ca	2	4	1	50
Duct ca	2	4	0	0
Ca. simplex	1	2	0	0
Gelatinous ca	1	2	0	0
	48	98*	8	

*The 2 per cent. missing is accounted for by our eliminating from consideration any fractional percentages to facilitate interpretation of the table.

Presence or Absence of Involved Axillary Nodes.—Of the 75 conclusive cases, pathological examination of the axillary contents proved the axillary nodes to be free from disease in 30 patients. Ten of these cases, or exactly 33 per cent. are alive and well at the present writing. This percentage is very much lower than the usual figure given by most writers, as will be seen from the following table:

TABLE VI

Percentage of Good Results in Cases without Axillary Involvement

Surgeon	Per cent. alive without recurrence
Lockwood	83 (4 yrs. or more)
Sistrunk and MacCarty	65 (5 to 8 yrs.)
Mills	63 (6 yrs.)
Greenough and Simmons	56 (5 yrs.)

It is a startling fact that only one patient of the entire 75 cases survived the five-year period without metastasis, where axillary nodes were found involved by the pathologist. This patient, Case No. 10, died without evidence of recurrence, of an intercurrent disease five years and nine months after operation. The almost uniformly bad result in the entire group following radical amputation in the presence of involved axillary nodes is the most striking feature developed by our study of this series.

Proper Interpretation of Signs of Early Chest Metastasis.—We believe that few surgeons to-day appreciate the early physical and radiographic signs of chest metastasis. Craver has pointed out that physical signs of early chest metastasis consist in "a peculiar limitation of breath sounds, especially marked during inspiration, covering a limited area of the chest. This may or may not be accompanied by fine, crackling râles during inspiration, or by pleural friction rubs." It is only in the latter stages of chest involvement that such subjective symptoms as shortness of breath and a dry hacking cough may be expected. The radiographic appearance of early chest metastasis may be characteristic a considerable time before the appearance of any subjective symptoms. We feel certain that chest plates are not infrequently passed as negative when true evidence of extension of the disease to the chest is revealed in the X-ray plate. Surgeons, as well as radiologists, often look for pronounced shadows, which are seldom seen early in the course of chest metastasis. In a joint communication with Herendeen, one of the writers has pointed out that the evidence of early metastasis consists "of hazy, line-like streaks along the bronchi, extending in a radiating manner from the hilum out into the parenchyma of the lung. It is usually bilateral and is generally more pronounced upon the side corresponding to the primary tumor. One may also see ill-defined mottling which in more marked cases gives almost the appearance of miliary tuberculosis. There may also be noted enlargement of the nodes at the hilum of the lungs."

Symptoms of Metastases to Bones.—Pain is the first symptom of metastasis to bones and the patient may complain before the X-ray plate will reveal

definite evidence of disease. The surgeon should be alert in investigating thoroughly any complaint of pain by the patient, especially in the region of the ribs, spine, pelvic bones or femur. Vague rheumatic symptoms should arouse the suspicions of the surgeon and a careful physical examination may reveal metastasis to bones in a patient who might otherwise be considered operable. In the order of frequency, bones involved are: Spine, pelvis, ribs (usually multiple), femur, other bones. In the present series, metastasis to the spine was known to have occurred in eight patients.

General Paths of Metastasis.—As most of the patients succumbing to the disease died outside of the hospital, no satisfactory statement can be made, concerning the situation or extent of metastasis. A considerable experience with mammary carcinoma has demonstrated that the most frequent path of metastasis is into the axilla of the same side, extending upward and ultimately involving the corresponding supraclavicular nodes. Metastasis into the chest is common and sometimes occurs early. Metastasis to the spine is unfortunately common and makes its appearance in the natural course of the disease, independent of any surgical intervention. The vast majority of cases coming to autopsy show almost invariably intrathoracic metastasis and often involvement of the liver.

Site of First Recurrence.—In 60 patients a note is made of the position of the first recurrence following operation. The subjoined table gives the percentage figures for the recurrent areas.

TABLE VII

	Per cent.		Per cent.
Supraclavicular (same side)	21	Intra-abdominal metastasis	9
Chest	19	Bones other than the spine	8
Spine	11	Opposite breast	6
Axilla (same side)	10	Opposite axilla	3
Adjacent skin	10	Brain	2
		Distant skin	1
			100

These figures can only give an approximate idea of the first situation in which evidence of the disease may be expected following operation. The careful follow-up of the present day would reveal a very much higher percentage of metastasis to the chest.

Treatment.—As surgeons, we have been accustomed to focus rather more upon the type of operation performed than upon the disease we are called upon to treat. Warren, in 1904, called attention to the fact that the result of the surgical treatment of mammary cancer depended largely upon the degree of malignancy of the process. Since the time when the modern radical operation devised independently by Halsted and Willy Meyer came into vogue, surgical treatment of this disease has been carried out with a high degree of technical skill. We have realized what a serious prospect faced the patient unless a complete removal of all malignant neoplastic tissue could

be accomplished. Still, in spite of the excellent surgery performed in the treatment of carcinoma of the breast, the problem of its complete control remains most difficult.

The astonishingly good results which are frequently obtained by some form of incomplete operation have impressed many operators. Greenough and Simmons obtained 26 per cent. of good five-year results, while in our own series 50 per cent. of the cases treated by local mastectomy have remained well without evidence of disease up to the present time. Mills reports nine out of fourteen cases, or 64 per cent., well and without disease six years post-operative. If we consider for a moment the reason for this splendid showing for the incomplete operation, it will be immediately apparent that the cases upon which this type of operation has been performed are usually those of a relatively low grade of malignancy, or cases in which the diagnosis of carcinoma before operation was questionable. Pathologists generally appreciate that papillary cyst-adeno-carcinoma, although grouped with the malignant neoplasms of the breast, is a relatively benign disease, and local mastectomy or even a wide local removal of the tumor may give a satisfactory end result in such a case.

In future surgeons should and will use the radical operation as the routine procedure for the majority of cases, but in exceptional instances a somewhat less extensive type of surgery may yield equally good results.

In this series but ten of the patients have received post-operative X-radiation, and most of these cases were treated by a technic which to-day is considered only reasonably efficient. Nevertheless, the average duration of life of these patients was three years and four months after operation. None of the ten were favorable cases, as axillary nodes were involved in each instance. The average length of life of 61 patients who received no radiation was three years, and this group included all of the favorable cases without metastasis to the axillary nodes. These figures are suggestive but not conclusive.

In the cases under consideration there was one operative mortality, Case No. 77 dying on the eleventh post-operative day from lobar pneumonia. The following table gives the operative mortality statistics in the hands of various operators:

TABLE VIII

Operative Mortality

Surgeon	Mortality per cent.	
Leech	7	
Greenough and Simmons	3.6	1894–1904
Halsted	3.6	
Warren	2	
Buchanan	1.5	
Lee and Cornell	1	
Sistrunk and MacCarty	0.5	
Crile	0	
Lockwood	0	
Greenough and Simmons	0	1911–1914

Late Results.—The following table illustrates the marked variation in the statistics of good end results furnished by different surgeons:

TABLE IX

Surgeon	Number of cases	Per cent. alive 5 years without recurrence
Haggard and Douglass	111	46
Sistrunk and MacCarty	218	39
Peck and White	69	39
Tixier	150	38 (6 yrs.)
Bunts	248	33
Greenough and Simmons	95	32
Lindenberg	183	28
Wiesman	106	23
Ochsner	98	22
Lee and Cornell	75	15

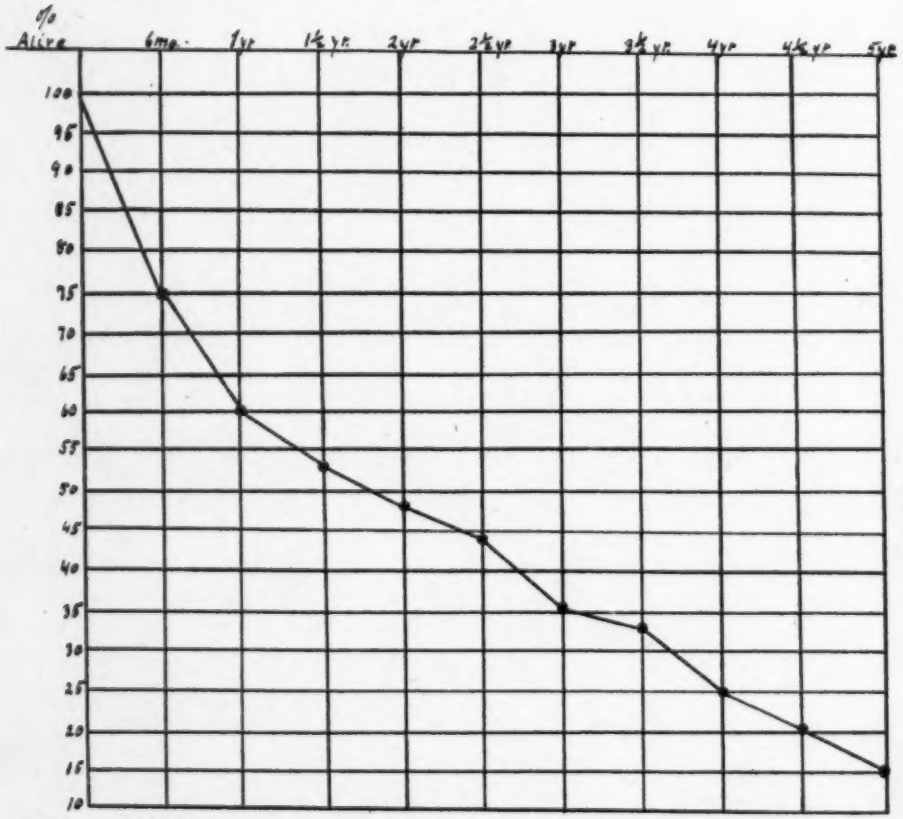


FIG. 5.—Table showing per cent. alive without recurrence at six month intervals up to five years.

The above graphic chart illustrates the rapid fall of percentages alive and well at six-month intervals down to the five-year period in the cases in this report.

CONCLUSIONS

1. Five-year results in the treatment of mammary cancer are the shortest ones worthy of report.

2. The five-year results in this series shows 15 per cent. alive and with no evidence of disease.

3. The term " cured " should be abolished and supplanted by " no evidence of disease to date."

4. Criteria of operability must be more sharply drawn.

5. The surgeon must learn to appreciate the physical and radiographic signs of early chest metastasis.

6. Metastasis to bones must be carefully excluded in every presumably primary operable case.

7. Continual follow-up of all post-operative cases is necessary if correct figures are to be obtained.

8. The term carcinoma of the breast probably includes a group of diseases differing in their pathology and their degree of malignancy.

9. Unusual pathological types should be collected in order that they may be separated out, the non-malignant from the truly cancerous.

10. In cases with involvement of axillary nodes, radical amputation usually yields disappointing end results.

BIBLIOGRAPHY

Buchanan, J. J.: Late Results in Two Hundred and Four Consecutive Cases of Amputation of the Breast for Carcinoma. Penna. Med. Jour., 1917–1918, vol. xxi, pp. 623–627.

Bunts, F. E.: End Results of Operations for Cancer of the Breast. ANNALS OF SURGERY, 1922, vol. lxxvi, pp. 341–345.

Craver, L.: The Value of Physical Signs in the Early Detection of Pulmonary Metastasis. Amer. Jour. Med. Sci. (to be published shortly).

Crile, G. W.: Observations on Cancer of the Breast with Analysis of Ninety-one Operative Cases. Ohio State Med. Jour., 1905, October.

Elser, W.: Verbal Communication.

Ewing, J.: Verbal Communication.

Greenough, R. B., and Simmons, C. C.: End Results in Cancer Cases. Cancer of the Breast. Boston Med. Surg. Jour., vol. clxxxv, pp. 253–261, 1921.

Haggard, W. D., and Douglass, H. L.: Tumors of the Breast. A Study of Two Hundred and Fifty-five Cases. Jour. Amer. Med. Assn., 1923, vol. lxxx, pp. 445–448.

Halsted, W. S.: The Results of Radical Operation for the Cure of Carcinoma of the Breast. ANNALS OF SURGERY, 1907, vol. xlvi, pp. 1–19.

Lee, B. J., and Herendeen, R. E.: The Treatment of Primary Inoperable Carcinoma of the Breast by Radiation. A Report of Fifty-four Cases from the Breast Clinic. Radiology, 1924, vol. ii, pp. 121–136.

Leech, P.: Results of One Hundred Operations for Carcinoma Mammæ. Brit. Med. Jour., 1910, vol. i, pp. 72–76.

Lindenberg, H.: Zur Statistik der Operativen Dauerhailungen des Mamma Carcinoms. Deut. Zeit. für Chir., 1914, vol. cxxviii, pp. 167–182.

Lockwood, C. B.: Cancer of the Breast. London, 1913.

Meyer, W.: Cancer of the Breast. Surg., Gyn. and Obstet., 1917, pp. 553–557.

Mills, G. P.: The Prognosis of Carcinoma Mammæ. A Review of One Hundred and Sixty-nine Cases. Brit. Jour. Surg., 1921–22, vol. ix, pp. 91–98.

Ochsner, A. J.: Final Results of One Hundred and Sixty-four Cases of Carcinoma of the Breast, Operated upon During the Past Fourteen Years at the Augustana Hospital. ANNALS OF SURGERY, 1907, vol. xlvi, pp. 28–42.

Peck, C. H., and White, W. C.: Tumors of the Breast, Benign and Malignant. A Review of Three Hundred and Thirty-one Cases. ANNALS OF SURGERY, 1922, vol. lxxv, pp. 641–651.

Rodman, W. L.: Cancer of the Breast. Jour. Amer. Med. Assn., 1915, vol. lxiv, pp. 707–711.

Sistrunk, W. E., and MacCarty, W. C.: Life Expectancy Following Radical Amputation for Carcinoma of the Breast; A Clinical and Pathologic Study of Two Hundred and Eighteen Cases. ANNALS OF SURGERY, vol. xxv, pp. 61–69.

Sutton, J. B.: Tumors Innocent and Malignant. London, 1922, 7th Ed.

Tixier, L.: A Propos des Resultats Eloignes du Traitment du Cancer du Sein. Lyon Chirurg., 1922, vol. xix, pp. 673–678.

Warren, J. C.: The Operative Treatment of Cancer of the Breast. ANNALS OF SURGERY, 1904, vol. xl, pp. 805–833.

Wiesman, E.: Ueber die Endresultate der in den Jahren 1896–1916 Operierten Mamma Carcinome. Beitrag zur klinis. Chirurgie, 1921, vol. cxxii, pp. 181–211.

THE SURGICAL TREATMENT OF HEPATIC CIRRHOSES*

By William J. Mayo, M.D.
of Rochester, Minn.

Mann, in his classical experiments in the laboratories of the Mayo Foundation, removes the entire liver from dogs, and when they are about to expire a few hours later, he introduces a solution of glucose into their veins, which resuscitates them immediately; the period of resuscitation may be extended for from twenty-four to thirty-six hours by continuing the injection of the glucose solution at intervals, but all urea formation stops. This discovery emphasizes the metabolic functions of the liver, such as the metabolism of carbohydrates producing sugar for the heat and energy of the body. In the metabolism of proteins also, the final steps in the development of the amino-acids take place in the liver, and in the liver, likewise, the fats are made fit for use in the body.

A function of the liver deserving of attention, is that of the destruction of protozoa and bacteria that are removed from the blood stream by the spleen and intestinal organs of the portal system. Adami demonstrated that the sterility of the upper intestinal tract is due not only to the action of the gastro-intestinal secretions, but to some extent to phagocytes which pass out of the portal capillaries to the intestinal surface, pick up particles of fat, and bacilli, and carry them into the radicles of the portal vein. The pigments of these microörganisms form the dark spots so common in the substance of the liver. Various bacterial toxins, and chemical poisons such as arsenic and phosphorus, are to a great extent detoxicated in the liver.

The bile might be regarded as a by-product of the metabolic processes in the liver, since the bilirubin of the bile is derived from the deteriorated red blood-cells destroyed in the liver and elsewhere, and excreted as bile pigment, and the cholesterol content of the bile, a lipoid stored in fat, is liberated in the liver. Bile functions in intestinal digestion, especially in relation to the metabolism of fats, and many of the elements of bile, including water, are reabsorbed in the intestinal tract.

An interesting fact in connection with the function of the liver is that the liver acts only on non-oxygenated blood. Rowntree and Chaney are now carrying on in the Clinic certain interesting experiments in which arterial blood or oxygen is transferred to the portal circulation, to determine the direct effects of oxygen on the function of the liver. The liver is peculiar in that all its cells are alike; consequently its diseases are of a simple pattern, as contrasted with those of organs with highly differentiated cells which introduce varied architectural possibilities. The star-shaped cell of Kupffer is not a true liver cell, but probably an endothelial cell of phagocytic type developed in the liver tissue spaces with specialized functions of a problematic nature. The

* Read by title before the American Surgical Association, April 19, 1924.

liver has remarkable powers of regeneration. Mann has shown that if 70 per cent. of the liver of a dog is removed, it will be replaced within twelve weeks, not alone by hypertrophy, but by hyperplasia of the remaining liver cells.

When the liver is overwhelmed by an acute destructive poison, bacterial or chemical, its cells undergo acute fatty degeneration, regardless of the nature of the toxic substance which produces it, and in forty-eight hours the greater part may be converted into fat. When the toxic invasion is chronic, connective tissue is developed instead of fatty degeneration. The type of cirrhosis is determined by the route by which the toxic substances enter the liver; if by way of the portal circulation, portal cirrhosis results, if through the bile channels, biliary cirrhosis. In the use of the term cirrhosis I have been guided more by the clinical aspects of cirrhosis of the liver as a whole than by the etiologic factors or the minute pathologic histology.

In portal cirrhosis, the most common type of cirrhosis, failure to eliminate or detoxicate toxic substances carried to the liver by the portal system leads to diffuse deposits of connective tissue around the portal vessels, which interfere with the hepatic circulation. Ascites, hemorrhage from the mucous surfaces, especially from the stomach, and other evidences of portal circulatory obstruction, are the end results of the vascular interference. The blood-pressure in the portal vein is about 30 mm., in the general circulation about 130 mm., and the back pressure on the portal circulation in portal cirrhosis is undoubtedly increased by the arterial counter-pressure. The work of Segall, showing the effect of ligation of the various branches of the hepatic artery on the circulation of the liver, is most interesting in this connection. In Laennec's type of portal cirrhosis, the liver is small, contracted, and nodular, but it should be noted that the cirrhotic liver may be normal in size, or considerably enlarged, and occasionally may be smooth from deposits of fat in the liver spaces.

There has been a tendency among pathologists, because of the varying morphology of the liver in portal cirrhosis, to describe each picture as a different type of cirrhosis, just as one might describe each pattern of wall paper or carpet as a different paper or carpet. Fagge, of Guy's Hospital, London early reported instances in which post-mortem examination revealed very advanced portal cirrhosis in men who, apparently in perfect health, had died suddenly as a result of accidents. With characteristic sagacity, Fagge pointed out that through collateral vascular connections, especially those described by Sappey, the portal circulation had been reduced in these cases to a point at which the decompensated liver was able to care for the circulation without the development of serious obstruction, ascites, or hemorrhage. Talma was the first to suggest the artificial establishment of a collateral circulation. Drummond, the physician, and Morison, the noted surgeon, working jointly on the same theory, introduced the operation of omentopexy to increase the collateral circulation, and attempted to produce vascular adhesions between the surface of the liver and the abdominal wall.

The surgical treatment of portal cirrhosis by the Talma-Morison operation has given some good results. Of forty-seven patients operated on in the Clinic, seven died in the hospital, twenty-one were alive when last heard from, one being alive and well more than nine years after operation, another eight years, one more than seven, and one more than five years. The operation we have usually performed is made through an epigastric incision as for gall-stone disease, just to the right of the median line, which permits examination of the liver, and a second lower incision through the skin and muscle down to the posterior aponeurosis and peritoneum. The rectus muscle is separated from its posterior attachments, and the omentum is drawn from above down into the extraperitoneal pocket thus formed. The extent of collateral circulation established in this way is extraordinary. In several instances I made an incision nearby for other purposes, some time after omentopexy, and encountered so much venous bleeding that I had to desist. The Talma-Morison operation *per se* carries only a slight risk, but ascites, hemorrhages, and often œdema of the lower extremities of the patients for whom it is indicated, make any operation extremely grave. The high mortality of the earlier Talma-Morison operations was undoubtedly largely due to the abdominal drainage through which peritoneal infections were subsequently carried. We have not used drainage, but have aspirated whenever necessary during the weeks succeeding operation, while collateral circulation is being established. The peritoneum in such patients is exceedingly vulnerable. Fagge demonstrated that 10 per cent. of the patients who came to post-mortem through cirrhosis of the liver, also had a terminal tuberculous peritonitis.

My interest in splenectomy for the relief of portal cirrhosis was excited many years ago by the remarkable benefit, such as the disappearance of ascites, hemorrhages, and other evidences of portal cirrhosis, which so often followed removal of the enlarged spleen in the Banti stage of splenic anæmia. It is a fascinating theory that in cases of splenic anæmia the spleen, which belongs to the reticulo-endothelial system, is enlarged primarily, and the liver contracted secondarily, suggesting that the toxic substances are carried to the liver from the spleen, a splenic type of portal cirrhosis. This theory would also argue that in the common type of portal cirrhosis of the liver, the liver is contracted primarily and the spleen enlarged secondarily. In other words, the toxic substances are not carried to the liver through the splenic portion of the portal vein, but through the gastro-intestinal portion of the portal vein, a true gastro-intestinal type of portal cirrhosis, and this is borne out by the fact that the enlargement of the spleen which occurs with the gastro-intestinal type of portal cirrhosis is not nearly so great as that with the splenic anæmia type, and secondary portal cirrhosis. This contrast is well shown in the gastro-intestinal type of portal cirrhosis of pepper and alcohol habitués, which is usually of the Laennec type, with only moderate enlargement of the spleen.

Experience in removal of the spleen in splenomegalias of the splenic anæmia type with secondary cirrhosis of the liver encouraged removal of the spleen in cases of the gastro-intestinal type of portal cirrhosis of the liver.

Forty-two of the ninety-seven patients splenectomized for splenic anæmia in the Clinic had more or less portal cirrhosis. Four patients died in the hospital; twenty-one are alive, two more than nine years, three more than seven years, four more than five years, and so forth. The results from splenectomy were extremely good and, contrasted with those from splenectomy in the gastro-intestinal type of cirrhosis of the liver, were remarkable, which again argues for an entirely different interrelationship between the spleen and the liver in these two conditions.

In ten cases of splenectomy, with three deaths in the hospital, for advanced gastro-intestinal portal cirrhosis the results on the whole were disappointing; while the spleen was only moderately enlarged, it showed generalized thrombophlebitis and atrophy of the pulp cells comparable with that found in the spleens in cases of splenic anæmia, and, considering the difference in the anatomic structure of the spleen, with the cirrhotic process found in the liver. In nine other cases splenectomy was combined with a Talma-Morison operation. Two of the patients died in the hospital. These patients were bad surgical risks and were operated on in the terminal stages; the results are none too encouraging as contrasted with the brilliant results following splenectomy for splenic anæmia with secondary portal cirrhosis. The normal spleen furnishes about 20 per cent. of the portal blood, the enlarged spleen much more. Splenectomy must necessarily reduce hepatic circulation. Perhaps part of the improvement may be due to the increased opportunity for collateral circulation in the vascular adhesions which form in the bed from which the spleen has been removed. I had occasion to operate for gall-stone disease on a physician on whom twelve years previously, C. H. Mayo had performed splenectomy for advanced splenic anæmia with marked cirrhosis of the liver. It was with the utmost difficulty that I worked my way down to the encapsulated liver, which fairly floated in a venous plexus. The patient otherwise was in splendid condition. Removal of the spleen for these terminal conditions of primary cirrhosis of the liver entails considerable risk and should not be lightly undertaken, but in selected cases combined splenectomy and omentopexy should be considered.

What has been called "hepatic shock" is sometimes noted after comparatively slight operations on patients with very advanced decompensation of the liver, and in cases of portal cirrhosis the diagnosis will often be delayed, or the operation will not be considered until the function of the liver is reduced to the point at which recovery is doubtful. There have been several unfortunate experiences of this kind in the Clinic.

Rowntree, on the medical service, Walters on the surgical service, and Greene, on the laboratory service of the Clinic, in collaboration have developed interesting and valuable facts from tests of liver function which demonstrate that, when the function of the liver is reduced to below 25 per cent. any serious operation will probably end fatally. Mann has shown that if the function of the liver in the dog is reduced to a point below 20 per cent., the animal will probably die.

In cases of biliary cirrhosis the liver is enlarged, dark colored, often soft, and has a tendency to bleed easily on slight injury. Biliary cirrhosis is most often the secondary result of infections and obstructive processes originating in the gall-bladder or the common duct, usually from gall-stone disease. As Adami has pointed out, stone in the common duct, or obstruction in the head of the pancreas, is the usual cause of dilatation of the fine biliary ducts. The slowing of the circulation of the bile invites infections in and around the small biliary channels, and the resultant introduction of connective tissue around the minute bile ducts produces obstructions in the liver which lead to early and continuous jaundice. The spleen is not greatly enlarged in this type of biliary cirrhosis. The biliary tract should be cleared of obstructions such as gall-stones, and free drainage of bile established; the results are usually good. Splenectomy is unnecessary.

There is another type of biliary cirrhosis in which there is no demonstrable infection or obstruction in the biliary ducts. The liver is enlarged and congested, but firmer in consistency than in obstructive biliary cirrhosis. All the biliary ducts are greatly thickened, and chronic jaundice exists. The spleen is enlarged and to a much greater extent than occurs in the obstructive type. It is interesting to speculate why the spleen is greatly enlarged in certain cases of biliary cirrhosis and not in others, and whether or not the splenic involvement is of definite significance. Hanot's name has been associated with an obscure type of hypertrophic biliary cirrhosis. I do not know just why his vague description, which has only added to the fog which surrounds the subject, should have resulted in an eponym.

Cases of what might be called the splenic type of biliary cirrhosis sometimes are graded according to the size of the spleen, but so far as I am able to judge clinically, the conditions associated with size are variations of essentially the same process. There are usually no gall-stones nor infections in this group, but if they exist, they are apparently incidental. The disease is very chronic and does not often present the acute symptoms exhibited in the obstructive type. Removal of the spleen sometimes seems to be indicated in these cases.

Just how removal of an enlarged spleen can be of benefit in such cases is a matter of speculation. The portal circulation in the liver is, of course, greatly reduced by splenectomy, and possibly this reduction is sufficient to reduce the amount of bile formed to the point where the obstructed channels can function. Splenectomy for hæmolytic icterus has been extraordinarily successful, yet we know little concerning the disease. Perhaps a closer relationship between hæmolytic icterus and certain splenic types of biliary cirrhosis may exist than is apparent on the surface. In twelve cases of splenectomy for the splenic type of biliary cirrhosis, there was one death in the hospital; five patients are alive. It is evident that such patients, at present, come to operation in a terminal condition, and are usually beyond the stage at which function of the liver can be restored.

There is a remarkable parallelism in the relation of an enlarged spleen to both portal and biliary cirrhosis. In the ordinary type of portal cirrhosis, it is often possible to trace the origin of the disease directly to the gastro-intestinal tract (for instance, to the irritation of alcohol and pepper), and the spleen is not greatly enlarged; the results of splenectomy are only fair. The operations usually performed have been at a terminal period, too late. In terminal portal cirrhosis seen in the Banti stage of splenic anæmia, the spleen is very large, and splenectomy may be curative. In biliary cirrhosis of the obstructive type of Adami, due to obstruction and infections such as are produced by gall-stone disease, the spleen is not greatly enlarged and there is no reason for splenectomy. Removal of the obstruction is sufficient. In these types of biliary cirrhosis in which there is no apparent infection or obstruction, in which the spleen is greatly enlarged, splenectomy may have value if not too long delayed. These facts lead to the tentative conclusion that there is a direct relation between the spleen and certain types of portal and biliary cirrhosis.

SUMMARY

In the present incomplete state of our knowledge, cirrhoses of the liver may be divided into two fairly definite groups: (1) portal cirrhosis, the result of deposits of connective tissue around the radicles of the portal vein, causing ascites and hemorrhages from the stomach, and (2) biliary cirrhosis, the result of deposits of connective tissue around the biliary duct system, causing chronic jaundice.

The portal cirrhoses may be of two distinct types clinically: a primary gastro-intestinal type, sometimes definitely the result of alcohol, pepper, or other irritating substances taken with food, in which the spleen is not greatly enlarged. In suitable cases, splenectomy and the Talma-Morison operation combined may have value. Splenectomy in addition to the Talma-Morison operation carries an increased risk, however, and before splenectomy is performed, the functional capacity of the liver should be tested. In the secondary splenic type of portal cirrhosis, occurring in the late stages of splenic anæmia, splenectomy gives splendid results.

The common forms of biliary cirrhosis are the results of obstructions and infections of the biliary ducts, usually associated with gall-stone disease, and removal of these infections and obstructions, in cases not too far advanced, can be expected to result in cure. The spleen is not grealty enlarged in such cases, and splenectomy appears unnecessary. There is a splenic type of biliary cirrhosis, however, very chronic in character, in which the splenomegalia is a prominent symptom and splenectomy may be indicated.

DIVERTICULITIS OF THE COLON*

By E. Starr Judd, M.D.
and
Lee W. Pollock, M.D.
of Rochester, Minn.
Section on Medicine, Mayo Clinic

Diverticulitis of the colon deserves repeated consideration because of the frequency with which it is encountered and the severity of the symptoms manifested in some of the cases. The treatment for the condition has not been definitely standardized and it may be difficult to decide between operative procedures and less radical measures.

Diverticulitis was first described by Virchow, in 1853, although apparently very little was known about it for many years afterward. Graser, in 1898, described a formation in the lower colon which he believed to be an acquired type of diverticulum. Fischer, in 1899, also described the condition, but the first comprehensive article affording a study of the etiology and classification of the several types was that by Beer in 1904. In 1907, Mayo, Giffin, and Wilson reported the first series of cases (five) in which operation had been performed. The cases were studied from the standpoint of the clinical features, histologic changes in the tissues, and the results of surgical treatment. Moynihan's paper on mimicry of cancer of the colon appeared the same year. Since then, a number of detailed reports have appeared in the English literature, by Telling, Drummond, Mummery, Hartwell and Cecil, Brewer, Rogers, and others.[5]

Although post-mortem statistics would indicate that diverticulitis occurs rarely, clinical experience, especially in the last decade, would indicate that it occurs often. In the Clinic during the last year, one-third of the positive X-ray examinations made of the colon disclosed diverticulitis or diverticulosis. Diverticula may be found in any part of the gastro-intestinal tract from the œsophagus to the rectum, but the condition which we speak of as diverticulitis occurs almost altogether in the sigmoid. Protrusions are fairly common in the right, transverse, and descending colon, although they do not usually cause symptoms, probably because inflammation seldom occurs in diverticula in these areas. All diverticula of the sigmoid do not result in inflammation, or manifest clinical signs; nevertheless, the sigmoid as a focus for diverticulitis is characteristic. In no other part of the colon do we find the bowel studded with rows of small saccules and the curious inflammatory thickening of the mesentery and other structures. Diverticulosis, or symptomless diverticula, occur in any part of the colon. Diverticula of the sigmoid are more likely to become inflamed because the hardened fecal content of this part

* Read before the American Surgical Association, Baltimore, Maryland, April 17–19, 1924.

of the colon probably makes greater pressure within the sigmoid than in the other parts of the colon, and the fecal matter pressed into these saccules results in irritation and inflammation.

Etiology.—Diverticulitis is a disease of middle life and old age. The average age of patients is about fifty-five years. The condition has been reported as occurring at the age of eighteen years. Two of Mummery's patients were twenty-one and twenty-three years, respectively. The youngest patient in our series was a boy aged fifteen years, and the youngest on record is seven years (Ashhurst). The condition in this case was, we believe, verified by operation. The fact that diverticula rarely occur in young persons would indicate that they are not congenital, although this point has been widely discussed. Undoubtedly there is a congenital predisposition, possibly because of inherent weakness of the musculature. They are more common in the male, and in our experience are more common in fleshy persons. Constipation was one of the chief complaints in 63 per cent. of our cases. In our review of these cases, it did not appear that obstruction, either from stricture or adhesions, is a factor in the development of the diverticula. In most instances there was no demonstrable narrowing of the lumen of the colon below the site of the diverticulum, and furthermore, it is rather unusual to find diverticula in a colon which is markedly obstructed, so that while pressure must be considered a factor in the cause, some other factor must be responsible.

Hansemann and Klebs first called attention to the fact that the protrusions were closely related to the blood-vessels, entering and leaving the intestine along the mesenteric border. However, not all protrusions bear this relationship to vessels, and this explanation cannot, therefore, be applied to all cases. The part played by pressure and constipation, the blood-vessels, and the congenital weakness of the wall of the colon in the production of those diverticula has been widely discussed, but most observers agree that a change takes place in the resistance powers of the wall. This change is probably slow, and does not result in true diverticula until middle life. The inherent weakness, combined with the pressure of fæces and gases in the intestine, is undoubtedly responsible for the condition.

Early in their development, diverticula are probably microscopic in size, and all of the protrusions are true diverticula and contain all of the coats of the wall of the colon. Very early, the musculature disappears, although the mucous membrane remains undisturbed. In our experience they have not been large. They are more common on the lateral wall of the colon; occasionally they have a definite relationship to the fat tags. Our observations during the last few years lead us to believe that, in most instances, diverticula do not become inflamed, and hence do not produce symptoms. Since X-ray examinations of the colon have become reliable, we are finding many cases of diverticula of the colon without clinical manifestations. We agree with Spriggs that these cases should be called diverticulosis in contrast to the others in which inflammation has developed. Wilson called attention to the mode of development of the inflammation in cases of diverticulitis. In several of the

specimens he examined, there had apparently been an escape of bacterial irritants without the epithelium of the sac showing inflammatory changes. Just outside the submucosa and within the fat or subserosa, he found a diffuse infiltration with leukocytes and a marked increase of fibrous tissue. He called this condition peri-diverticulitis, and also directed attention to the fact that symptoms arising from the condition would be from inflammation in the peritoneum and not in the colon or diverticulum. It is likely that peri-diverticulitis is the condition represented by a rope-like sigmoid with extensive infiltration of the fat and mesentery.

Secondary Pathologic Changes.—Undoubtedly the diverticulum is the primary condition. It is not necessarily progressive, as shown by the fact that we have observed a great many patients for several years without discovering signs of change in the condition. The first change that occurs in the diverticulum is inflammation. We have recently been particularly interested in a study of the X-ray findings in these cases with regard to the marked tendency to spasm of the colon. Spasm of the colon is, of course, a common occurrence, but the frequency with which it occurs in cases of diverticulitis is significant. Inflammatory changes in a diverticulum are practically identical with the changes which may occur in the appendix. Diverticulitis has been called the left-sided appendicitis of old people. When the pouch becomes inflamed and fæces accumulate in it, the muscle atrophies, the mucous membrane becomes thin and ulcerated, the ulcer may perforate and result in a local abscess. This abscess may enlarge until it ruptures into the intestine, or seals itself to the abdominal wall and perforates to the outside, or it may burst into the bladder, resulting in a colovesical fistula. We have seen many patients in whom an abscess had formed and ruptured into one of these viscera, but as yet have not observed the development of general peritonitis. In the 118 cases of diverticulitis of the sigmoid in which operation was performed at the Clinic, fourteen localized abscesses were found in the peritoneal cavity, three in the abdominal wall, one in the wall of the bladder, one in the wall of the rectum, and one in the liver. Besides these, eight abscesses had perforated directly into the bladder, so that fæces and gas were passing through the urethra.

Usually the inflammatory process is chronic, and fibrous tissue is deposited in and around the colon. Many adhesions form, and often a tumor composed of dense fibrous tissue results. In this tumor small abscesses and diverticula containing fæces may often be found. The same condition usually occurs in several diverticula at once; the process is slow, probably taking several years. As a result of this chronic inflammation, stenosis of the sigmoid follows. The lumen of the sigmoid is reduced by the contraction of the fibrous tissue from the outside. The mucous membrane remains intact, so that in this respect a stricture from diverticulitis differs from a stricturing carcinoma. Blood was passed from the bowel in only 18 per cent. of the cases of benign diverticulitis, while it was found in the stool in more than 47 per cent. of the cases associated with carcinoma. A palpable tumor was present in 34 per cent. of the benign cases, and in 31 per cent. of those associated

with carcinoma. Constipation was one of the principal symptoms in about 60 per cent. of the cases, but enough interference with the bowel to cause obstruction was present in fifteen of the entire group of 137 cases. Many other patients had had obstructive attacks, as shown by the history, but there was no obstruction at the time they came for treatment.

It is likely that some of the patients with an indefinite history of chronic abdominal attacks have them as a result of inflammation in a solitary diverticulum. One of the problems which presents itself to the surgeon seems to be the decision of whether the symptoms are caused by the diverticulum. It has also been suggested that diverticulitis may act as a focus of infection, and be the cause of remote symptoms. Rogers, writing on diverticulitis, reports one case of this kind which was entirely relieved by treatment for the diverticulitis. The mesentery usually becomes œdematous and thickened, and extends up over the sides of the colon. As a result of this swelling, and often after the inflammation in the mesentery has subsided, the colon may be pulled into a distinct angulation, which may be the cause of obstructive attacks. As a result of this angulation, it is often difficult to examine the colon satisfactorily with the sigmoidoscope, but when the characteristic condition is found, it strongly indicates diverticulitis.

One of the interesting problems in the study of these cases is the association of carcinoma with diverticulitis. In the 118 cases in this series in which operation was performed, there was no evidence of carcinoma. During the same interval we operated on nineteen patients with diverticulitis of the sigmoid associated with carcinoma. Some years ago, Wilson called attention to the manner in which diverticula of the sigmoid might become carcinomas, comparing the cases of carcinoma of the stomach developing secondary to ulcer of the stomach, and carcinoma of the appendix developing secondary to inflammation in the appendix. We are unable to demonstrate whether this larger series of cases will bear out the contention that diverticulitis may result in cancer. In many of our patients in which carcinoma and diverticulitis were associated, there seemed to be no relationship between the two conditions, the carcinoma having apparently developed independent of the diverticulum. In some instances there were only one or two small diverticula remote from the carcinoma in the wall of the colon. It is probable that a patient with diverticulitis is no more likely to develop malignancy of the colon than one without it.

Clinical Manifestations.—One of the striking features brought out in our study of these cases was the number in which diverticulitis had been diagnosed, and in which there were no clinical manifestations. This is largely owing to the fact that the X-ray now shows much better detail of the colon than formerly, and probably the colon is being examined more routinely. We examined 615 cases of undoubted diverticula of the colon, but in only 137 were the symptoms sufficiently severe to warrant surgical intervention. We realize, however, that palliative measures can accomplish a great deal in some cases. The principal symptoms in our cases were pain, which was present

in nearly 80 per cent.; constipation, in about 60 per cent.; abdominal tenderness, in over 60 per cent.; gas in the bowels in over 30 per cent., and palpable tumor in 34 per cent. of the benign cases, and in 31 per cent. of those associated with carcinoma, thus showing that the presence of a tumor indicates diverticulitis rather than carcinoma, although this is not an important point in the differential diagnosis. When blood is present in the stool, it suggests carcinoma rather than diverticulitis. Frequency, and burning and pain on urination, often accompany diverticulitis of the sigmoid. Frequency was noted in more than 20 per cent. of our cases. Cystoscopic examination may be of value in cases in which the colon has perforated into the bladder. One of our patients, whose only symptom resulting from this condition was pus and mucus in the urine, had been treated a long time for cystitis, and the true condition was revealed only on cystoscopic examination. In the remaining seven cases in which there was a fistula between the colon and the bladder, the diagnosis could be made readily from the presence of inflammation in the region of the sigmoid, and the passage of gas and fæces into the bladder.

Proctoscopic examinations are not of much value except to rule out other conditions. The lesion is likely to be too high to be reached with the proctoscope, and the deformity and angulation of the sigmoid make it inadvisable to attempt it. Fixation of the sigmoid may interfere with the passage of the sigmoidoscope in diverticulitis, and when found is corroborative evidence. We have seen the stoma of a single diverticulum through the sigmoidoscope, and also the rugous, fixed, mucous membrane lining a stricture due to diverticulitis.

In the differential diagnosis, if a mass is present in the sigmoid, the point of importance is to distinguish between the diverticulitis and carcinoma. This is often impossible, and in many instances in which the abdomen is open and the tumor palpated, it cannot be determined whether the lesion is diverticulitis or carcinoma, or diverticulitis and carcinoma. The history of repeated attacks of inflammation in the left lower abdomen with subsidence of symptoms is the rule with diverticulitis. But the case in which the patient presents himself within a short time after his first attack, with a palpable mass in the bowel, and partial obstruction still present, will always remain a diagnostic problem, so far as the differentiation of diverticulitis and carcinoma is concerned. The presence of blood or bloody mucus persistently in the stools indicates carcinoma. Ulceration of the mucosa in the strictured area of a diverticular involvement occurs occasionally, and severe bleeding may result, but this is rare. Persistent low-grade fever may be present with both conditions. Leukocytosis is a little more common with diverticulitis than with carcinoma, but there is not enough difference to be of value. We believe that, for the present at least, these two conditions must usually be distinguished by histologic examination of the tissues.

The X-ray reveals two types of diverticula: those associated with spasm, inflammatory thickening of the intestinal wall and partial obstruction, seen

most often in the sigmoid and called diverticulitis, and those distributed in various parts of the colon, without spasm, thickening or narrowing and called diverticulosis. When diverticula are filled with barium, they are seen as rounded or oval shadows projecting from the intestinal lumen. Such shadows, in conjunction with spasm or organic narrowing of the bowel, are pathognomonic of diverticulitis. The differential diagnosis is chiefly concerned with carcinoma, phleboliths, calcified glands, urinary calculi and barium pent up in contracted haustra.

Diverticula may fail to fill with barium if they contain fecal matter or have a stenotic inlet, and in such event diverticulitis may resemble carcinoma. Carcinomatous diverticulitis, if extralumenal shadows are present, cannot be distinguished from benign diverticulitis. By manipulation during the screen examination shadows of the concretions mentioned may be shown to have no relation to the bowel. Normal barium-filled haustra are not accompanied by a filling defect, and tend to disappear or to change their situation. Diverticular shadows maintain a fixed position and may persist after the bowel is emptied.

Treatment.—In view of the fact that we have seen a number of these patients, even when they had an abscess or a tumor, entirely relieved by conservative treatment, we are tempted to follow this plan in a large percentage of cases. We are, however, constantly confronted with the fact that the condition may be malignant, and that we are allowing an operable condition to become inoperable. We are convinced that the process is not progressive, and that unless there are symptoms from the diverticula no treatment other than palliative, such as regulation of the bowel movements, is indicated. Conservative measures, rather than operation, should be seriously considered in all of these cases. Operations have thus far been performed with a mortality of about 10 per cent. In operating, infection is the serious consideration. Although the tissues in these cases are not filled with bacteria to quite the extent that they are in cases of ulcerative colitis, nevertheless, there is usually a virulent infection in the wall of the colon and mesocolon. While the patient may be combating this satisfactorily before operation, the manipulation of the tissues may result in spreading the infection rapidly. We have operated on a number of patients who had abscesses, either just draining the abscess, or draining and suturing the opening left in the colon at the point of perforation of the diverticulum. In some instances the wound had healed readily, while in others fecal fistulas have persisted for a long time. If the condition is chronic, and results in obstruction from tumor and angulation of the colon, it is possible to resect the sigmoid and perform the anastomosis at one time, with satisfactory results in most instances. If, however, there is an appreciable amount of infection in or near the colon, or if there is a fistula from the colon leading into the bladder or other structures, the mortality will be reduced considerably by a preliminary colostomy, which accomplishes more than just the relief of obstruction. After the colostomy

has been established, the distal part of the colon, which is affected with the diverticulitis, can be flushed out thoroughly once or twice a day until all evidence of infection has disappeared; the resection can then be performed with comparative safety. Because of the serious consequences following resection for diverticulitis, Mummery has advised permanent colostomy in some cases, being content with this procedure rather than operation at such risk. In most cases, however, we feel that after all the inflammation has subsided, resection and reëstablishment of the continuity of the colon can be attempted.

TABLE I

BENIGN DIVERTICULITIS

January 1, 1907 to January 1, 1924

	Patients	Per cent.	Hospital mortality	Per cent.
Number	118		12	10.16
Males	84	71.18	8	9.52
Females	34	28.81	4	11.76
Oldest male	75 years	Oldest female	76 years	
Youngest male	15 years	Youngest female	28 years	

AGES BY DECADES

Years	Patients	Per cent.
11 to 20	1	0.84
21 to 30	1	0.84
31 to 40	12	10.16
41 to 50	37	31.35
51 to 60	42	35.59
61 to 70	18	15.25
71 to 80	7	5.93

TABLE II

BENIGN DIVERTICULITIS

January 1, 1907 to January 1, 1924

	Patients	Per cent.
Symptoms:		
Pain	90	76.27
Constipation	63	53.38
Abdominal tenderness	64	54.23
Gas in the bowels	42	35.59
Palpable tumor	41	34.74
Abdominal distention	27	22.88
Blood in stool	22	18.64
Painful bowel movement	20	16.92
Mucus in stool	15	12.71
Pus in stool	8	6.77
Liquid stool	3	2.54
Obstruction	11	9.32
Frequency of urination	24	20.33
Burning on urination	21	17.79
Pain on urination	17	14.40
Large amount of pus in the urine	11	9.32

TABLE III

BENIGN DIVERTICULITIS

January 1, 1907 to January 1, 1924

Findings at Operation

	Patients	Per cent.
Location of tumor:		
Sigmoid	88	74.57
Rectosigmoid	7	5.93
Colon	5	4.23
Cæcum	5	4.23
Colon and sigmoid	4	3.38
Rectum	4	3.38
Not stated	5	4.23
Associated conditions:		
Adhesions	76	64.40
Perforation	31	26.27
Obstruction	25	21.18
Abscess localized in region of diverticula	14	11.86
Abscess in abdominal wall	3	2.54
Abscess in vesical wall	1	0.84
Abscess in rectal wall	1	0.84
Abscess in liver	1	0.84
Abscess under liver	1	0.84
Fistula into bladder	8	6.77
Fistula into sigmoid	1	0.84
Fecal fistula	1	0.84
Sinus of abdomen	1	0.84
Stones in the diverticula	4	3.38
Peritonitis	3	2.54
Associated findings:		
Gall-stones	5	4.23
Large spleen	1	0.84
Carcinoma of the pancreas	1	0.84
Inoperable carcinoma of the rectum	1	0.84
Duodenal ulcer	1	0.84
Tuberculous glands and secondary infection	1	0.84
Cyst of the liver	1	0.84

TABLE IV

BENIGN DIVERTICULITIS

January 1, 1907 to January 1, 1924

	Patients
Types of operation:	
Mikulicz	35
Tube resection	12
Resection	21
Colostomy	15
Excision of the diverticulum	15
Drainage of abscess	7
Anastomosis	7
Exploration	6
Total	118

REPORT OF CASES

CASE I (*A433746*). *Extensive deverticulitis of the sigmoid relieved by cæcostomy.*—A woman, aged fifty-six years, had had an abdominal exploration one month before coming to the Clinic, because of pain in the left lower quadrant, lasting one week. A tumor 3.75 cm. in diameter was found in the sigmoid, causing adherence to the broad ligament. A cæcostomy was performed.

We found that the cæcostomy was functioning satisfactorily and the patient felt well, but she desired to know the nature of the lesion. Extensive diverticulitis of the sigmoid was demonstrated by X-ray. With control of diet, and irrigations, the patient continued to improve, and finally was sent home without further operation. She reports that she has been entirely comfortable thus far.

CASE II (*A208146*). *Diverticulitis of the sigmoid without marked symptoms.*—A woman, aged forty-six years, came to the Clinic because of intermittent and increased menstrual bleeding. She had had a goitre for twelve years, and slight constipation.

Our examination revealed multiple uterine fibromas, and an adenomatous goitre, which was not causing symptoms. At operation September 21, 1917, multiple fibromas, causing a tumor about 12 cm. in diameter, were found in the uterus. At the rectosigmoidal juncture was a mass 3 cm. in diameter which showed evidence of perforation, as it was sealed against the peritoneum covering the posterior portion of the uterus near the internal os on the left side. A subtotal hysterectomy was performed and the rectosigmoid juncture resected. The pathologists reported that the segment of sigmoid contained diverticulitis.

The patient recovered uneventfully from the operation and returned home. When told of the presence of the diverticulitis, the patient recalled that in the previous four years she had had occasional slight distress in the left abdomen accompanied by constipation and inability to pass gas; she had been relieved by a bowel movement or flatus.

CASE III (*A387471*). *Extensive diverticulitis of the sigmoid without marked symptoms.*—A man, aged fifty-six years, had developed a sore mouth, nine months before, and had noticed that he had a geographic tongue. Later his Wassermann reaction was reported to be positive, and he was given treatment for syphilis. In June, 1923, he passed a small amount of blood with his stool. In the three months which have intervened, his bowels have been regular until two weeks before coming to the Clinic, when he took Pluto Water. This was followed at first by a bloody discharge, and later by a severe hemorrhage, necessitating transfusion. Since the hemorrhage he had felt weak and sluggish, but had not had any pain or definite discomfort.

X-ray examination disclosed diverticula of the sigmoid with partial obstruction. At operation September 27, 1923, extensive diverticulitis and rather marked obstruction from long, thickened adhesive bands of inflammatory diverticula were found. The involved area was brought to the outside as the first stage of the Mikulicz operation, and ten days later was cut off. The patient's convalescence was somewhat retarded on account of the marked secondary anæmia, although two transfusions of 500 c.c. each had been given before the operation. The final stages of the operation were not completed, and after a month the patient was permitted to return home to complete his convalescence.

CASE IV (*A387719*). *Perforating diverticulitis of the sigmoid and vesicosigmoidal fistula.*—A physician, aged sixty years, one month before examination, had had a sudden, sharp, lower abdominal pain, followed by fever, a mass in the left lower quadrant, frequency and burning on urination, and the passage of gas by the urethra.

Examination revealed a great deal of pus in the stools, pus 2 and albumin 2 in the urine, hæmoglobin 68 per cent., and leukocytes 19,900. A median pelvic mass was palpable by rectum. Operation April 24, 1922, revealed that the sigmoid and descending colon were thick and œdematous; the descending colon was almost rope-like. The sigmoid was obstructed and densely adherent to the posterior wall of the bladder. All of the tissues were reddened, œdematous, and acutely inflamed; in some areas watery œdema was

present. The mesentery was thick and œdematous. A left rectus colostomy was performed. About a year later, inflammatory tissues around the colostomy wound, and an anal fistulous tract were excised. No evidence of malignancy was demonstrable in the tissues.

In the two years since the primary operation, the patient has regained his former weight, and he wrote recently that he was enjoying good health.

Case V (*A382782*). *Diverticulitis of the sigmoid causing obstruction and marked toxæmia.*—A woman, aged fifty-five years, during the last four years had had three attacks of extreme soreness in the left iliac fossa, accompanied by a rise in temperature and severe constipation. An abdominal exploration revealed a mass in the sigmoid, but no attempt was made to remove it.

The nature of the tumor was of the greatest concern to the patient, although marked obstruction was evident at the time of our examination. The X-ray revealed multiple diverticula of the sigmoid and descending colon. The hæmoglobin was 67 per cent., the leukocytes 9900. At operation February 4, 1922, diverticulitis of the sigmoid had caused a suspicious-appearing tumor. The Mikulicz operation was performed in four stages. The pathologists reported multiple diverticula, averaging 1 by 0.5 cm. in diameter, and peridiverticulitis. Microscopically, there was no evidence of malignancy. About 30 cm. of bowel was removed.

The patient left our care in April, 1922, in good condition, and when last heard from, was improving steadily.

Case VI (*A93664*). *Diverticulitis of the sigmoid with obstruction and spontaneous abdominal and vesicosigmoidal fistulas.*—A man, aged forty years, began to have abdominal cramps five years before coming to the Clinic. In an attack four years before, he had had chills, fever, and pain in the left lower quadrant followed by superficial inflammation. The inflamed area was incised and drained, but there was a rather persistent discharge of pus. One year later it was necessary to repeat the procedure, and several abscess pockets were evacuated. A third attack occurred one year before the visit to the Clinic, and was followed by a discharge of pus through the old sinus tract and also through the urethra. Two operations did not relieve this condition.

A fecal fistula was found in the left groin; it had been opening and closing intermittently for a year. The X-ray examination of the colon was unsatisfactory on account of the loss of bismuth through the fistula. Operation October 22, 1918, disclosed dense adhesions throughout the pelvis. A ruptured diverticulum of the sigmoid was discharging through the fistulous tract. The intestinal loop above the area of diverticulitis was dilated to three times normal. The involved sigmoid was resected and anastomosed by a tube.

The patient was dismissed from observation on the thirtieth day after operation in good condition, and has not been heard from since.

Case VII (*A453119*). *Perforating diverticulitis of the sigmoid and vesicosigmoidal fistula.*—A man, aged fifty years, had had several attacks of constipation or diarrhœa, associated with abdominal cramps, fever, and occasional chills, for eight years. For the last ten days repeated cathartics had failed to obtain a bowel movement, although enemas resulted in the passage of a little gas and a small quantity of fecal matter.

Examination revealed marked tenderness over the descending colon, normal temperature, and 12,000 leukocytes. X-ray examination of the colon disclosed a filling defect in the sigmoid, and obstruction suggestive of diverticulitis. A day or two later, the patient suddenly developed frequency of urination, dysuria, and passed gas by urethra. There was increasing toxæmia and distention of the abdomen, especially the left lower quadrant. With a dietary régime and laxatives, the toxæmia decreased, and the bowels moved freely during the following two weeks. Operation February 11, 1924, disclosed acute perforating diverticulitis, communicating with the bladder. Colostomy was performed, and no further exploring done on account of the acuteness of the condition.

Recovery was uneventful, and the patient left our care on the twenty-first day, feeling well.

CASE VIII (*A442388*). *Diverticulitis of the sigmoid. Relief of symptoms by medical management.*—A man, aged sixty years, had had mild lower abdominal distress, easily relieved by laxatives for one year. One month before, he had had an attack of severe lower abdominal pain followed by a rise in temperature, tenderness and rigidity in the lower left quadrant, and had been kept in bed for three weeks, because of swelling of the abdomen; this subsided.

Our examination disclosed nothing abnormal, grossly. X-ray examination of the sigmoid demonstrated the presence of diverticula. Mineral oil and a restricted diet were advised, and the patient left for home October 1, 1923.

In a report dated February 1, 1924, he states that he has gained 20 pounds, is not entirely free from symptoms, but has had only one day of severe discomfort and that occurred within the last month.

CASE IX (*A376337*). *Diverticulitis of the sigmoid and emphysema of the scrotum.*—A physician, aged forty-six years, in the last three years had had two attacks of intermittent left lower abdominal pain, lasting eight and six months respectively. The pain increased with defecation; it was accompanied by constipation, and at times a rise in temperature. There was frequency, and pain and burning on urination.

Urinalysis revealed pus 3 and albumin 1 in the urine. A rather marked cystitis was present. Rectal palpation revealed a mass in the region of the sigmoid, and the X-ray the presence of diverticulitis, causing obstruction. At operation, November 9, 1921, diverticulitis of the sigmoid was found. A loop of the small intestine (the ileum) had become attached to the mass and the posterior wall of the bladder, due to the inflammatory reaction, and the descending colon was dilated, giving evidence of obstruction. The infection was acute at the time, and there was considerable œdema and inflammation around the tumor. Primary resection seemed inadvisable because so many structures seemed to be involved, and a left rectus colostomy was made. November 6, 1923, after a long tedious dissection, the sigmoid was freed and resected, and an end-to-end anastomosis made.

On the seventh day after the colostomy, the patient rapidly developed an emphysema of the scrotum, but after puncture of the colostomy loop, the condition subsided. In the two-year interval between the operations, the patient gained 50 pounds. He is now waiting to have the colostomy closed.

CASE X (*A448543*). *Perforating adenocarcinoma and diverticulitis of the sigmoid; carcinoma of the ileum and obstruction.*—A man, aged fifty-eight years, had had three or four attacks of abdominal cramps eight years before, which were said to be due to appendicitis. Six months before, constipation had increased, and for three months was accompanied by abdominal cramps. Six weeks later he noticed a frequent desire to go to stool; the fæces were liquid and contained much mucus. From this time on he lost strength and 25 pounds in weight. A few days before his visit to the Clinic he vomited for the first time.

Examination revealed tenderness over the lower abdomen, blood and excess mucus in the stools, and obstruction in the sigmoid. About forty-eight hours after examination of the colon, the patient developed tenderness and severe pain in the lower left abdomen, and became toxic. A definite mass was palpated at the level of the pelvic brim, but this disappeared after three weeks of hospitalization. Proctoscopy at this stage revealed a fixed lesion 20 cm. beyond the sphincter. On mineral oil and a soft diet he improved a great deal during the next three weeks. Operation, January 18, 1924, disclosed an adherent sigmoidal mass at the brim of the pelvis which gave the feel and appearance of a carcinoma. The sigmoid was indurated above the mass. There was no evidence of distant metastasis. A colostomy was performed, and a month later, the mass, which consisted of sigmoid, a loop of adherent ileum, and the appendix, were removed. There was an annular adenocarcinoma of the sigmoid 4 cm. long, and a carcinoma 2 by 1.5 cm.

long in the ileum. Glandular involvement was not demonstrable. Small diverticula were found in the bowel, both above and below the growth. March 25, the colostomy was closed and the continuity of the bowel reëstablished. The patient's convalescence has been uneventful.

CASE XI (*A147966*). *Perforating diverticulitis of the sigmoid and mesenteric abscess.*—A man, aged fifty-two years, had had attacks of cramping pain in the left lower abdomen for one year. Enemas and mineral oil afforded moderate relief. The left lower abdomen had been tender since an attack of abdominal pain three weeks before. The bladder was irritable at this time.

Examination revealed tenderness and a mass in the left lower quadrant. X-ray examination of the sigmoid revealed diverticulitis. Operation, December 28, 1915, disclosed a tumor of the sigmoid 10 cm. long, closely adherent to the pelvic wall, extensive inflammatory reaction in the surrounding tissues, and an abscess in the mesentery with the tip of the appendix drawn into it. The appendix was removed and the first stage of the Mikulicz operation performed, bringing the tumor and 25 cm. of the bowel to the outside through an incision in the left rectus muscle. January 5, 1916, the second stage of the Mikulicz operation was performed, and the tumor removed. January 18, the third stage was performed. The patient recovered satisfactorily.

CASE XII (*A399677*). *Diverticulitis of the sigmoid and vesicosigmoidal fistula.*—A man, aged sixty years, had had attacks of pyrexia for five years, and had noticed large amounts of sediment in the urine, and for three years, flatus at the end of micturition.

Urinalysis revealed albumin 2 and pus 3. Cystoscopic examination revealed an opening in the wall of the bladder through which fecal matter could be seen. X-ray examination of the colon revealed diverticulitis. At operation August 29, 1922, it was found that the opening in the bladder had occurred at about the middle of the left lateral wall. Many diverticula were present in the sigmoid above the point of its attachment to the bladder. The sigmoid and bladder were separated and the openings closed.

The convalescence was uneventful, although prolonged on account of an indolent superficial fistula in the region of the left groin; this eventually healed spontaneously.

CONCLUSIONS

1. Diverticulitis of the colon is more common than was formerly believed. There may be a solitary diverticulum in any portion of the colon, or a great many diverticula distributed from the ileocæcal valve to the rectum.

2. Diverticulitis is apparently not progressive, and may remain unchanged for years. In many instances it apparently does not cause symptoms.

3. Diverticulitis is a disease of middle life. The condition we speak of as diverticulitis is peculiar to the sigmoid. We have not observed the condition, which is a diffuse œdema, inflammation, and swelling throughout all of the tissues of the colon and mesentery, in any other quadrant of the colon.

4. As the inflammation in the diverticula and wall of the colon progresses, an abscess may form and later perforate into the abdominal wall, bladder, or intestine. If the inflammation remains chronic, a tumor composed of fibrous tissue and the products of inflammation develops.

5. It is often difficult to distinguish between diverticulitis of the sigmoid and carcinoma; in a number of the cases the conditions are associated. Just what influence diverticulitis has on the development of carcinoma, we are unable to determine. If the history reveals that the patient has had repeated similar attacks, and has noticed a tumor for a long time, increasing and receding from time to time, the probability is that it is due to a diverticulitis. In

some instances, a definite diagnosis cannot be made until the tissues have been examined histologically.

6. Many patients with diverticulitis can be relieved by dietary and medical management.

7. If an abscess forms from the perforation of a diverticulum, or extension of the infection through the wall of the colon, drainage is indicated. If perforation occurs into other regions, an operation is the only procedure that offers relief.

8. If there is any question as to the nature of the tumor, operation is indicated.

9. The mortality from radical operations for diverticulitis has been very high. The difficulty in these cases has arisen from stirring up the infection that existed in the tissues around the colon before the operation. It seems to us from a review of the results in these cases, that the plan of procedure should be a preliminary colostomy for the purpose of caring for any obstruction in the colon, and particularly the reduction of the inflammation in the diverticula by frequent irrigations of the lower colon. Resection of the infected portion can then be made with less risk.

BIBLIOGRAPHY

[1] Ashhurst, A. P. C.: Sigmoid Diverticulitis (Mesosigmoiditis) in a Child. ANNALS OF SURGERY, 1908, vol. xlvii, pp. 300–305.

[2] Beer, E.: Some Pathological and Clinical Aspects of Acquired (False) Diverticula of the Intestine. Am. Jour. Med. Sc., 1904, vol. cxxviii, pp. 135–145.

[3] Brewer, G. E.: A Consideration of the Etiology of Certain Cases of Left-sided Intra-abdominal Suppuration (Acute Diverticulitis). Tr. Am. Surg. Assn., 1907, vol. xxv, pp. 258–269.

[4] Drummond, H.: Sacculi of the Large Intestine, with Special Reference to Their Relations to the Blood-vessels of the Bowel Wall. Brit. Jour. Surg., 1917, vol. iv, pp. 407–413.

[5] Erdmann, J. F.: Acute Diverticulitis of the Colon. New York Med. Jour., 1919, vol. cix, pp. 969–972.

[6] Fischer, M. H.: False Diverticula of the Intestine. Jour. Exper. Med., 1900–1901, vol. v, pp. 333–352.

[7] Giffin, H. Z.: Diverticulitis of the Rectum. A Report of Two Cases Operated on, One of them with Carcinomatous Degeneration. ANNALS OF SURGERY, 1911, vol. liii, pp. 533–537.

[8] Giffin, H. Z., and Wilson, L. B.: A Case of Carcinoma on Diverticulitis of the Sigmoid. Am. Jour. Med. Sc., 1909, vol. cxxxviii, pp. 661–666.

[9] Graser, E.: Darmstenose bedingt durch Perforation multiper falscher Divertikel. Verhandl. d. deutsch. Gesellsch. f. Chir., 1898, vol. xxvii, pp. 98–101.

[10] Graser, E.: Ueber falsche Darmdivertikel. Verhandl. d. Gesellsch. deutsch. Naturf. u. Aertze, 1899–1900, vol. ii, pp. 14–15.

[11] Hansemann, D.: Ueber die Entstehung falscher Darmdivertikel. Arch. f. path. Anat., 1896, vol. cxliv, pp. 400–405.

[12] Hartwell, J. A.: Perforating Diverticulum of Ascending Colon. ANNALS OF SURGERY, 1910, vol. li, pp. 269–270.

[13] Hartwell, J. A., and Cecil, R. L.: Intestinal Diverticula. Am. Jour. Med. Sc., 1910, vol. cxl, pp. 174–203.

[14] Klebs: Quoted by Beer.

[15] McGrath, B. F.: Intestinal Diverticula. Their Etiology and Pathogenesis, with a Review of the Twenty-seven Cases. Surg., Gynec. and Obst., 1922, vol. xv, pp. 429–444.

[16] Masson, J. C.: Diverticulitis of the Large Bowel. Can. Med. Assn. Jour., 1921, vol. xi, pp. 106–111. Also: Colorado Med., 1921, vol. xviii, pp. 235–238.

[17] Mayo, C. H.: Diverticula of the Gastro-intestinal Tract: Their Surgical Importance. Jour. Am. Med. Assn., 1912, vol. lix, pp. 260–264.

[18] Mayo, W. J.: Diverticulitis of the Large Intestine. Jour. Am. Med. Assn., 1917, vol. lxix, pp. 781–785.

[19] Mayo, W. J.: Diverticulitis of the Sigmoid. Virginia Med. Month., 1921, vol. xlviii, pp. 427–433.

[20] Mayo, W. J., Wilson, L. B., and Giffin, H. Z.: Acquired Diverticulitis of the Large Intestine. Surg., Gynec. and Obst., 1907, vol. v, pp. 8–15.

[21] Moynihan, B.: Mimicry of Malignant Disease of Large Intestine. Brit. Med. Jour., 1906, vol. ii, p. 1817.

[22] Mummery, J. P. L.: Diseases of the Rectum and Anus. London, Baillière, Tindall and Cox, 1914, 348 pp.

[23] Rogers, J. T.: Diverticulitis of the Colon. Minn. Med., 1923, vol. vi, pp. 35–39.

[24] Telling, W. H. M.: Acquired Diverticula of the Sigmoid Flexure, Considered Especially in Relation to Secondary Pathologic Processes and Their Clinical Symptoms. Lancet, 1908, vol. i, pp. 843–850; 928–931.

[25] Wilson, L. B.: Diverticula of the Lower Bowel: Their Development and Relationship to Carcinoma. Annals of Surgery, 1911, vol. liii, pp. 223–231.

[26] Virchow, R.: Historisches, kritisches und positives zur Lehre der Unterleibsaffektionen. Arch. f. path. Anat., 1853, vol. v, pp. 348–352.

SURGERY OF THE RIGHT HALF OF THE COLON*

By John B. Deaver, M.D.
of Philadelphia, Pa.

The right half of the colon differs embryologically from that of the left half. The proximal colon is developed from the mid-gut. It comprises that portion of the bowel which extends from the ileocæcal junction to the splenic flexure. This portion of the bowel, especially the cæcum, the ascending colon and the hepatic flexure is a frequent site of disease.

Within recent years much has been written on the subject of carcinoma of the large bowel. However, a careful perusal of the literature will show that the attention of surgeons has been focused chiefly on that portion of the colon which is most frequently affected, that is, the sigmoid, recto-sigmoid and rectum.

It is very difficult to obtain a careful comparison of the occurrence of cancer of the colon to that of other organs. In the collected statistics of Hoffman, he gives as the cause of death in the registration area of the United States in the years from 1908 to 1912, cancer of the stomach and liver, 80,316; cancer of the buccal cavity, 7716; of the skin, 7585; of the female generative organs, 30,997; of the female breast, 18,884; of the peritoneum, intestines and rectum, 25,644; and cancer of other or unspecified organs, 31,559. It is interesting to note that when this is considered at the rate per 100,000 of population 7.7 of the male and 11.3 of the female deaths are due to cancer of the peritoneum, intestines and rectum. It is of further interest to note that while in 1900 only 5.7 of the deaths per 100,000 were due to cancer of the peritoneum, intestines and rectum; in 1913 this had risen to 10.5. It may be said that this increase was due to more careful diagnosis. On the other hand, Hoffman points out that "there is no evidence that the disease groups to which cancer might erroneously have been assigned have materially decreased, if at all, coincident with the gradual rise in the cancer death rate."

When we come to consider the frequency of cancer of the large bowel with that of the small bowel, we find the following statistics:

At the Pathological Institute of Vienna, of 343 intestinal carcinomas which came to autopsy, 164 were in the colon and 162 in the rectum, while only 7 were in the duodenum and 11 in the ileum. In Schleip's collection series of 542 intestinal carcinomas, 257 were in the rectum, 269 in the colon, 20 in the duodenum and 16 in the ileum. In Brill's series of 3563 intestinal tumors 97.5 per cent. were in the colon, appendix or rectum. In Herman's collection of 20,544 cancer cases, 1706 had a lesion in the large intestine, 1204 in the rectum and only 20 in the small bowel.

An analysis of numerous statistics made in order to determine the frequency of cancer of the various anatomic parts of the large bowel gave the

* Read before the American Surgical Association, April 18, 1924.

following figures. In Mummery's collection of 188 cases of cancer of the large intestine, exclusive of the rectum, 103 had carcinoma of the sigmoid flexure, 6 of the descending colon, 12 of the splenic flexure, 17 of the transverse colon, 3 of the hepatic flexure, 6 of the ascending colon and 41 of the cæcum. At the Mayo Clinic from January 2, 1915, to December, 1922 of 359 cases of cancer of the colon; 71 were of the cæcum; 44 of the ascending colon; 28 of the hepatic flexure; 50 of the transverse colon; 23 of the splenic flexure; 39 of the descending colon; and 104 of the sigmoid flexure.

Of 511 deaths from carcinoma of the large bowel reported by Azeman, Maydl, Müller and Nothnagle, 35 were from cancer of the cæcum (6.8 per cent.); 131 the colon (25.6 per cent.); 83 the sigmoid (16.2 per cent.), and 262 the rectum (51.2 per cent.).

Erdman, in a series of 108 cases of carcinoma of the large bowel, reported 39 in the recto-sigmoid, 4 in the left one-quarter of the transverse colon and the splenic flexure, 12 in the hepatic flexure and the right three-quarters of the transverse colon; the remainder of the cases he did not localize.

It is in general agreed that if we consider the question of carcinoma of the colon, excluding those of the rectum, about 36 per cent. occur in the sigmoid, and 25 per cent. in the cæcum, the transverse colon and the splenic flexure; the hepatic flexure and the ascending and descending colon are accountable for the rest in about that order of frequency. In the Lankenau Clinic among the last sixty cases requiring surgery (exclusive of fecal fistula and non-malignant obstruction) the right half of the colon was involved fifteen times, or 25 per cent. of the cases.

Before taking up the various clinical aspects of the subject, it is of importance to discuss the factors which may predispose to the development of carcinoma in this portion of the bowel. This is especially true if we accept as true the statistics which show a steady increase in the incidence of the disease. If we can recognize the conditions which precede and those which produce cancer of the colon, we will have taken a long stride forward in its control and prevention.

Trauma to the bowel, as elsewhere, is a common predisposing factor in the production of cancer. Added to this we have the various degenerative changes which occur in the body tissues, which have been ascribed merely to age and again to intestinal putrefactive processes, and still again to syphilis. The most important factor, however, is unknown. It may be organismal or not. It may be, however, that this unknown factor acts in conjunction with one or the other of the known factors and the absence or presence of one or the other decides for or against malignant degeneration.

The right half of the bowel affords an excellent illustration of the manner in which trauma produces ulceration and carcinoma. I am one of those who believe that chronic ulceration plus traumatism is all that is necessary to produce malignant change. The lesions of the tongue are also an excellent example of this. The cæcum and hepatic flexure may be compared with the sites in the œsophagus and the cardiac and pyloric portions of the stomach

where cancer develops in those locations subject to constant injury. Most of us will agree that if the irritant is allowed to exert its baneful influence over a sufficient period malignancy results.

In the large intestine stasis is very frequent. Marked ptosis of the transverse colon with a resulting increase in the back pressure in the right half of the colon affords sufficient trauma. Associated with this we frequently find the mucous membrane showing varying grades of inflammation.

When we come to consider the difference in frequency in cancer of the right half and of the left half of the bowel, it should be pointed out that the consistency of the contents of the large intestine varies, for while in the cæcum and ascending colon it is still liquid or pasty, in the iliac and pelvic colon it is hard and firm. The greater frequency of cancer of the cæcum in comparison with that of the splenic flexure may be due to the fact that the caput of the colon is similar to a reservoir.

It is unfortunate, though true, that the surgeon is still not consulted until either the tumor is grossly palpable or the patient is suffering from an acute or chronic obstruction. Although outwardly these may be the first signs, a careful history will show that the patient has had either pain, cramp-like in character, or discomfort, giving only a sense of some intestinal derangement. At times the patient will localize accurately the area in which exaggerated peristalsis is attempting to overcome a partial obstruction. Long before the tumor is palpable, borborygmi may have been noticed. Irregularity in fecal evacuations are fairly constant and, if the lesion is in the right half of the colon, this may be in the form of diarrhœa. Sir Berkeley Moynihan has said that in his cases "it was very rare to find constipation as a symptom of a growth in the right colon, and rare to find it absent in a growth of the left colon." The constituents of the fæces may also be altered and blood is probably always present and can be found if repeated examinations are made. The excess of mucus associated with colonic tumors is due to an inflammation of the mucosa above the growth. An early anæmia is especially significant of tumors in the right half of the colon, Moynihan finding it in 50 per cent. of the patients with growths of the ascending colon and in 20 per cent. of all colonic growths. In fact, the blood picture may simulate that of pernicious anæmia.

The tumor at first is small and may not be palpable unless the individual is thin. At times the tumor felt is not the actual growth, but is an accumulation of fæces behind it. Occasionally visible peristalsis is present, or if this cannot be seen, under careful palpation the bowel may be felt to distend and then slowly to relax under the hand, as the contents of the colon pass the obstruction.

Carson, in his analysis of 111 colonic cancers, found that 68 (62 per cent.) were in the iliac or pelvic colon, of which 50 per cent. were obstructed; 18 (16 per cent.) were in the cæcum or ascending colon, of which 33 per cent. were obstructed; 9 (8 per cent.) were in the transverse colon, of which 6 (66 per cent.) were obstructed; 9 (8 per cent.) were in the descending colon, of

which 7 (77.7 per cent.) were obstructed; and 6 (5.4 per cent.) were in the splenic flexure, of which all were obstructed. This shows that the neoplasms of the right half of the colon are second in frequency to those of the ileopelvic colon and are much less liable than any of the growths of the large bowel to become acutely obstructed, while the splenic flexure and descending colon growths are obstructed in 90 per cent. of the cases.

The patients are usually in advanced life, but numerous cases have been reported between the ages of twenty and thirty, so that youth does not exclude the possibility of cancer of the colon. Statistics show that the male is more commonly affected than the female, the proportion being from two to one to three to one.

I feel that it is a mistake to rely too much on the X-ray examination in diagnosis. In fact, where the clinical diagnosis has been clear, the X-ray findings have frequently been negative. The surgeon who waits for the X-ray to give positive findings may miss the favorable time when radical operation may affect a cure.

The chief conditions to be differentiated from cancer of the right half of the colon are tuberculosis and actinomycosis, bands and adhesions causing partial obstruction, chronic appendicitis, and occasionally diverticula. Since these conditions are primarily surgical, it would seem that accurate diagnosis is only of academic interest, while procrastination is accompanied by serious hazards.

The colonic cancer usually develops slowly. It remains restricted to the intestinal wall for a long time. Sampson Handley, some years ago, shocked the surgical profession when he announced that he had found permeation of cancer cells six inches from an apparently localized growth. However, I think he later partly denied the assertion. There can be no doubt that for a long time adeno-carcinoma of the right colon is confined to the mucosa and submucosa. During the process of growth the cells spread by (*a*) direct extension, (*b*) through the venous system, (*c*) through the lymphatic system. Hausmann's statistics are of the greatest importance. Thus in 112 autopsies on cases of cancer of the colon, in 21 the disease had spread beyond the bowel and become generalized; in 36 only the primary lymphatic glands were enlarged; and in 55 the disease was limited to the bowel. These figures compiled from patients dying of cancer of the colon showed that fifty per cent. of them had died without any sign of the growth outside of the bowel. This low-grade malignancy of these cancers should afford the surgeon an opportunity for excellent results if the cases are operated before contiguous structures are involved.

In 359 cases from the Mayo Clinic, 140, or about 39 per cent., had metastasis to lymph-nodes or to other organs. In these the primary growth was in the cæcum in 34 cases; in the transverse colon in 25, and in the sigmoid in 36. Stated in percentages metastasis had occurred in 48 per cent. of the cæcal growths, 50 per cent. of those in the transverse colon, 35 per cent. of the sigmoid cancers, and 31 per cent. of those situated elsewhere.

Only one who has operated on many of these cases can understand the varying malignancy of colonic tumors. In no other part of the body is there a wider variation in the degree of malignancy. The duration of life after simple colostomy in inoperable cases is often prolonged as compared with that of inoperable carcinoma in general. The virulence of bowel cancer depends more upon the seed than the soil. The colloid cancer is most malignant, the scirrhous cancer next, and the fungating type the least malignant. Generally the growth is slow, and for a long time the disease is limited to the bowel, the lymphatic glands being invaded late.

With such a state of affairs it is interesting to inquire into the number of patients presenting themselves for treatment who are suitable for a radical or a palliative operation. These statistics must be accepted with some reservation since surgeons vary in their opinions as to radical operability, and furthermore, the older statistics show a lower operability than the more recent ones. This is ideally illustrated in the Mayo Clinic reports where, during the years 1910 to 1913, 51 per cent. of the cases of cancer of the rectum had the radical operation, while in the succeeding two years (1913 to 1915) 71.8 per cent. of the cases were deemed suitable for radical intervention. Accurate statistics on the operability of tumors of the right half of the colon are not available, since what one surgeon considers suitable for radical intervention may be considered unsuitable by another. Again, I quote the statistics from the Mayo Clinic. In the 359 cases of cancer of the colon before mentioned, 125 were in the cæcum and ascending colon, and over two-thirds were found suitable for radical resection. McGlannan, in a series of 98 cases of cancer of the colon, found that 61 gave a history of an obstruction of some sort before operation. The suitability of the lesion for radical operation depends first upon the location of the area, second, upon the extent of the lesion and the metastasis, and third, upon the associated local or general disease. Under this heading I also consider obesity, since this is a disease, and there can be no doubt that the mortality is higher in obese patients.

There are definite contra-indications to the radical operation. If the lymphatic glands at a distance from the area to be excised are invaded by cancer cells, I doubt the advisability of the radical operation. The removal of the lymph-glands in the ileocæcal region is comparatively simple, since these glands lie along the ileocolic and the right colic arteries. Enlarged glands are not necessarily cancer invaded. Jameson and Dobson have carefully worked out the lymphatic drainage of the colon. They classify the glands into four groups: (1) the epicolic glands which lie on the bowel wall, and drain into the next two groups; (2) the paracolic glands, which lie in the mesentery along vascular arches close to the gut; (3) the intermediate glands, lying on the arterial branches between the vascular arcades and the main trunk, and the main glands situated around the colic arteries close to their origin, and into which all of the foregoing drain. It must be remembered that infection, which invariably accompanies cancer, may be the cause of glandular enlargement. On the other hand, growths in the hepatic flexure and the right half

of the transverse colon metastasize to glands about the pancreas and along the side of the aorta. The radical removal of the carcinoma in this latter region is, therefore, much more difficult and is attended by greater hazards. All of us have seen cases in which only local excision of the growth was practiced and the patient lived comfortably for a number of years. Paul, of England, emphasized this in 1912 when he said, "Many cases having the minute structure of cancer have not recurred, though known to have been removed within an insufficient margin of safety." He also said, "malignant disease of the bowel is very rarely removed during the early stage, yet the percentage of cures is remarkably good." Further contra-indications to the radical operation are deep invasion of the muscles of the posterior abdominal wall or extension to the parietal peritoneum. Moynihan believes that it is feasible to remove the invaded muscles without adding to the gravity of the operation, thus the contra-indications also vary according to the surgeon. William J. Mayo has shown that with increasing boldness and skill on the part of the surgeon in attacking growths of the large bowel the percentage of patients cured has been greatly increased, even though the operative mortality has been increased.

Whether the operation should be done by the one, two or several stage method is a matter of some controversy. The pioneers in this field resorted to the use of a temporary colostomy done either at the time of the radical operation or as the first stage of this operation. As surgery progressed, and as infection and wound healing were better understood, the one-stage operation took precedence over the two-stage procedure. I believe that in the ileocæcal region conditions still favor the one-stage operation. The contents of the bowel are fluid and their infective power is not nearly so great as in the left half of the colon. The ileum is nearly completely covered with peritoneum and the peritoneum of the large bowel is sufficient to give adequate serous approximation. Resection of the right half of the colon is therefore safer and easier than of the left half. To these factors may be added the greater mobility of the right half of the colon and the fact that its blood supply is more constant than that of the left half. Judd and Rankin have suggested ileostomy in all resections of the colon. This, they say, serves as a "safety valve." The only indication that I can see for the two-stage operation for cancer in the right half of the colon is in cases suffering from acute obstruction when first seen.

Cumston and Vandervere, in 1902, reported 83 cases of excision of the cæcum for cancer. Of 73 of these in which accurate statistics were obtained, 30 died under the operation and 43 recovered from the operation. McGlannan, in 1914, reported 32 cases of cancer of the cæcum, 10 of whom were cured, 18 of whom were dead, and 4 of whom were living but inoperable. He also reported 17 cases of cancer of the ascending colon and hepatic flexure, one of whom was cured, 15 of whom were dead, and one living and inoperable. How long after operation the death occurred, or how long after operation the "cures" were reported is not stated in his report.

In McGlannan's cases a two-stage operation was done when acute obstruction was present, and a one-stage operation in the other cases.

Other conditions which are occasionally met with in the right half of the colon requiring operation are actinomycosis and tuberculosis. These practically always occur in the cæcum. Waring reported seven cases of actinomycosis of the cæcum or appendix and to these have been added 14 cases by Brogen, ten of which originated in the ileocæcal region. Two forms of the disease are seen, the acute form which resembles appendicitis, and the chronic form, which is insidious in onset and associated with slight, indefinite pain in the right lower abdomen. Occasionally there is no pain, a mass being the first sign of the disease. In both types there is marked loss of weight and strength, associated with a pronounced anæmia, the skin over the mass becomes bluish-red and sinuses are frequent. Constipation and not diarrhœa

TABLE I.

Summary of Operations on Right Half of the Colon: Fifteen Cases, Among Last Sixty Cases of Surgery of the Colon. (Exclusive of Fecal Fistula and Obstruction.)

Diagnosis	No.	Operation	Resection and ileocolostomy	Ileosigmoidostomy	Ileocolostomy	Ileojejunostomy	Total
		Exploratory					
Carcinoma cæcum.....	5	1	1	1	2		5
Carcinoma hepatic flexure..	2			1	1		2
Carcinoma ascending colon.	4		3		1		4
Tbc. cæcum.....	4	1	2			1	4
	15	2	6	2	4	1	15

is the rule. The difference from carcinoma is that the latter is slower in growth, the anæmia is not so pronounced, diarrhœa is the rule and blood in the stools is more constant. The carcinomatous mass is more movable, causes no discoloration of the skin and there is no tendency to invade the anterior abdominal wall or to sinus formation. It is usually impossible to remove all the diseased tissue at operation because of the diffuse infiltration. The most that can be done is to drain the abscesses, curette the sinuses and irrigate the area. At the same time large doses of potassium or sodium iodide should be given by mouth and the area in the region of the infection treated by the Röntgen-ray.

Tuberculosis at the ileocæcal region is not uncommon. Fenwick and Dodwell report 85 per cent. of the cases of intestinal tuberculosis as involving the ileocæcal region. The disease may be localized or disseminated. Two forms are described, the ulcerative and the hypertrophic. The ulcerative form may simulate actinomycosis, while the hypertrophic form simulates carcinoma or occasionally appendicitis. The hypertrophic form is by far the more frequent and is characterized by anorexia, intestinal upsets and pain in the right iliac fossa, diarrhœa and constipation, with occasional attacks of partial or complete obstruction. The tumor is hard and somewhat nodular and by

TABLE II

Number	Sex	Age	Diagnosis	Operation	Pathology	Operative result	End result
1415/23	Male	65 yrs.	Carcinoma cæcum	Exploratory 3–9–23	Large mass (carcinoma) in right iliac fossa. Metastasis to bladder wall, mesentery of small bowel; carcinomatous mass near pyloric end of stomach. Primary growth undetermined.	Recovery	Died 4 months after discharge.
2132/23	Male	49 yrs.	Carcinoma cæcum	Resection ileocolostomy, 7–4–23	Hard mass, size of lemon, in cæcum. Piece of omentum adherent to cæcum—excised. Terminal ileum and cæcum resected; ileocolostomy, lateral anastomosis	Recovery	Five months (444).* Feeling well; occasional pain in scar; gain of 26 lbs. since discharge.
549/22	Male	58 yrs.	Carcinoma cæcum	Ileocolostomy, 2–23–22 Hemorrhoidectomy, 3–22–22	Mass in cæcum extending to hepatic flexure. Gall-bladder adherent to mass; stones palpated in gall-bladder Large external hemorrhoids	Recovery	Failed to reply to various inquiries.
1804/21	Male	72 yrs.	Carcinoma cæcum and descending colon	Ileo-sigmoidostomy, 7–12–21	Diffuse carcinoma involving cæcum; small carcinoma involving descending colon	Recovery	Thirty-one mos. (420). Did well for 14 months. Then began to fail. Now has constant diffuse pain in abdomen. Gas passes with difficulty. Colon distended. Sleep and appetite good.

M. F....	Male	54 yrs.	Carcinoma cæcum	Ileocolostomy. Excision dermoid cyst of transverse mesocolon, 9–19–19	Mass, size of hen's egg removed from mesocolon. Cæcum tied down by mass adhesion at ileocæcal valve, carcinoma	Recovery	No follow-up.†
31/24	Female	39 yrs.	Carcinoma hepatic flexure	Ileocolostomy, 1–4–24	Large growth on hepatic flexure, involving ascending colon. Inoperable. Ileocolostomy, lateral anastomosis	Recovery	.....
2654/22	Male	55 yrs.	Carcinoma ascending colon	Resection and ileocolostomy, 9–11–22	Large hard mass, size of orange on ascending colon. Metastasis to mesenteric lymph-nodes. Six inches of ileum and all of cæcum and ascending colon with part of transverse colon resected. Ileocolostomy, lateral anastomosis	Recovery	Died 12 months after operation
2016/21	Male	48 yrs.	Carcinoma ascending colon	Resection and ileocolostomy, 7–7–21	Annular carcinoma, size of hen's egg on ascending colon, about 5 inches from cæcum. Resection of bowel. Ileocolostomy	Recovery	Did well for 11 months. Then 2 small nodes appeared in incision. Gradual decline. Died 4–22–22 (22 months after operation.)
243/21	Female	50 yrs.	Carcinoma hepatic flexure	Ileosigmoidostomy, 1–4–21	Large hard nodular mass adherent to under surface of liver, involving head of pancreas. Neoplasm of hepatic flexure. Omentum adherent to cæcum, pulling down transverse colon. Ileocolostomy	Recovery	Failed to reply to inquiries.
M. F....	Male	66 yrs.	Carcinoma ascending colon	Ileocolostomy, 8–18–19	Neoplasm on ascending colon. Preliminary ileocolostomy. Secondary operation not performed	Recovery	No follow-up.†

*Patients are rated according to results.

† Follow-up system inaugurated 1920. Cases before that time not followed for this study.

TABLE II—*Continued*

Number	Sex	Age	Diagnosis	Operation	Pathology	Operative result	End result
S. E.....	Male	49 yrs.	Carcinoma ascending colon	Resection and ileocolostomy, 4–3–19	Small intestine distended, ascending colon, distended as far as hepatic flexure. Obstruction at hepatic flexure. Ileocolostomy at middle of transverse colon	Recovery	No follow-up.†
3612/23	Male	37 yrs.	Tbc. cæcum	Cecectomy. Ileocolostomy, 11–14–23	Great omentum adherent to cæcum and parietal peritoneum. Wound enlarged, ileocolstomy	Recovery	Four months (444)*. Wound healed in 2 months No complaints. Bowels regular. Appetite good.
857/22	Female	35 yrs.	Tbc. cæcum and ascending colon. Pregnancy	Exploratory, 3–20–22	Extensive process involving cæcum and ascending colon. Uterus contains 4-months fetus	Recovery	5-1-22 hysterotomy. Seven months improved. Eighteen months operated elsewhere, release of adhesions, of cæcum and obstruction of cæcum and descending colon. Gaining strength (434).
L. G....	Female	22 yrs.	Tbc. cæcum	Ileocolostomy, 1–16–19	Many adhesions about ascending colon too dense for separation, either tbc. or carcinoma	Recovery	No follow-up.*
2331/22	Female	34 yrs.	Tbc. cæcum	Ileojejunostomy jejuno-jejunostomy, 8–1–22	Point of obstruction, about 5 cm. long between a distended and collapsed portion of small bowel; lateral anastomosis above distended portion; second anastomosis lower down. Entire jejunum and part of ileum infiltrated by what appears to be a tuberculous process	Recovery	Died one month after discharge.

palpation may be indistinguishable from carcinoma. Tuberculosis more frequently occurs below the cancer age. The treatment is entirely surgical, consisting of complete removal of the diseased area with a side-to-side or end-to-side anastomosis.

Another lesion of this area requiring surgery is appendiceal fecal fistula. The complication of appendiceal fecal fistula is confined to the cases presenting perforation, abscess and requiring drainage. In the last 4063 cases of appendicitis at the Lankenau Clinic, there were 200 of appendiceal fecal fistula, an incidence of approximately 5 per cent. In every instance more or less pus was present necessitating drainage, and in the vast majority of cases some ulceration of the cæcum or terminal ileum was noted at the time of the primary operation. The cases which had perforated at the base of the appendix displayed the greatest tendency toward the formation of a fistula. Of the 200 fistulæ, 74, or 37 per cent., healed spontaneously, while 97, or 48.5 per cent., required operative repair. The remaining 29, or 14.5 per cent., left the hospital without operation. No doubt a certain proportion of these closed spontaneously. The type of operation for the repair of the fecal fistula depended upon the conditions existent at the time of operation. In 60 per cent. of the cases simple inversion of the fistulous opening by a purse-string linen suture, reinforced by an additional suture line sufficed. In 15 per cent. the condition of the bowel was such as to excite doubt as to its regenerative power in the presence of the fecal stream, so that an added ileocolostomy was performed. In 25 per cent. there were either multiple fistulæ or an opening so large as to preclude closure with maintenance of the lumen of the bowel. These required resection of the bowel varying from a small portion of the cæcum to resection of a foot or more of the terminal ileum with the cæcum and ascending colon. Ileocolostomy was of course the last stage of the operation.

CARCINOMA OF THE COLON*

By Charles H. Peck, M.D.
of New York, N. Y.

This report is based on a study of 69 cases of carcinoma of the colon excluding the rectum, treated on the Second Surgical Division of the Roosevelt Hospital since 1909.

The grave character of the disease; the high operative mortality, the frequency of recurrence after resection; the large percentage of cases too advanced to permit of removal when first seen, all tend to make the outlook in these cases far from encouraging.

It is the object of this paper to try to demonstrate the fact that carcinoma of the colon compares favorably with malignant disease elsewhere in percentage of operability and in favorable results both immediate and late, following radical operation.

It is true that many cases first seek surgical advice when the disease is well advanced and beyond hope of surgical cure. Many are first seen in acute obstruction when the diagnosis can only be surmised and emergency colostomy or enterostomy must be resorted to as a life-saving measure. Some of these patients when questioned later give a history of increasing constipation or attacks of partial obstruction, which should have given warning leading to an earlier diagnosis; other attacks come suddenly in patients in apparent good health.

A case now under my care illustrates this type. A woman of fifty had always been well until January of this year when she had an attack of cramp-like abdominal pain attributed to indiscretion in diet which passed off under treatment by catharsis in two or three days. There was no previous history of increasing constipation or abdominal pain, and after the attack the bowels moved normally until a second attack of pain and distention occurring three weeks later, failed to respond to catharsis and enemata, and emergency cæcostomy had to be performed for complete obstruction on February 6, 1924. Radical operation by the two stage, (Mikulicz) method, performed on March 8th, revealed a large carcinoma at the splenic flexure, without glandular metastases or secondary deposits: the lumen of the gut at the growth was barely the size of a lead pencil. She made a good operative recovery.

The first symptom to attract attention may be attacks of colicky pain with abdominal distention, with increasing constipation in the intervals. Careful palpation when the abdomen is flat may reveal a mass, especially when it is located in the cæcum; ascending or transverse colon; the lower end of the descending colon or sigmoid. When at or near the hepatic or splenic flexures it may be difficult or impossible to locate; as it is also in obese or very muscular patients or in the presence of abdominal distention. The discovery of a mass or tumor may be made before any obstructive symptoms have developed or

* Read before the American Surgical Association, April 17, 1924.

other evidence of disease has appeared, or bleeding from the bowel may be the first warning. Bleeding may appear as a single large hemorrhage, as bleeding repeated in moderate amount or as occult blood in the stools. In some cases, especially right colon growths, severe secondary anæmia, debility and loss of weight, may precede local evidence of the disease.

Whatever the initial symptoms may be, a thorough diagnostic investigation should be made at once and the site of the growth located as nearly as possible. When advanced obstruction is present, colostomy or enterostomy must precede this investigation and it is often impossible or unwise to attempt to locate the growth by exploration when this is done. It is far better to do a cæcostomy or ileostomy on the right side than to jeopardize the patient by a difficult exploration in the presence of extreme distention. When the distention is relieved, the abdomen should be carefully palpated for a mass; digital examination of the rectum (a procedure too often omitted) and sigmoidoscopy should be done, and X-ray examination after barium enema, the most valuable of our newer diagnostic methods.

Great care must be taken in interpreting colon radiographs, as apparent filling defects occur from various causes and erroneous conclusions are not infrequent. Differential diagnosis must be made from many other conditions which cause obstruction or abdominal distention.

Obstruction from bands or kinks; from partial volvulus of redundant loops of sigmoid; from impacted fæces in elderly people; distention from paralytic ileus in the course of systemic disease, *e.g.*, pneumonia are all conditions in which we have seen errors of diagnosis made. When the diagnosis has been established and the site of the growth located either by diagnostic examination or exploratory operation, the plan of treatment must be determined.

In many cases the presence of a large, fixed growth; of local extensions or involved lymph-nodes, or of palpable nodules in the liver, make it all too evident that palliative colostomy is the only operation to be considered. In the massive advanced growths without much obstruction it is often wise to omit even this procedure, to avoid the distress and annoyance of a fecal opening during the last few weeks of life.

Sometimes a short circuit operation may be done for obstruction; or it may be justifiable to resect a large painful growth even when nodules are present in the liver, especially when it can be done safely by the two-stage method; for the relief of pain and obstruction. We have done this twice; once in a recent case still under treatment; a large growth at the splenic flexure, without lymph-node involvement or local extension but with multiple nodules in both lobes of the liver. The other case, a descending colon growth with liver involvement, recovered from the operation and was relieved of abdominal symptoms but died 73 days later of cerebral metastases.

Pathologic Types.—There are several gross pathologic types of which the most common are the round ulcer, and the scirrhus contracting growths.

The round ulcer gradually increases in size until if left alone it finally encircles the gut, contracting as it grows and producing as a rule marked

constriction. The growth advances in the submucous layer beyond the limits of the ulcer; the edges are piled up and thickened, not generally undermined, the base is covered with unhealthy granulations which bleed easily. The cases vary in the proportions of cell mass to fibrous tissue, some being quite dense and hard, others spongy and cellular; the latter bleed most easily. While the rate of growth varies greatly, it is often slow, and glandular metastases and the development of secondary deposits in the liver are fortunately often long delayed. It is the type which in the long run offers the best hope of successful eradication.

The scirrhus contracting type is also slow of growth, narrowing the gut lumen as the growth progresses until finally attacks of partial obstruction give warning of its presence, or the narrowed opening may be suddenly plugged with a mass of hardened fecal matter and complete obstruction ensue apparently out of a clear sky. While this type is also of relatively low malignancy with late metastases, not infrequently exceptions to this rule occur in the form of liver nodules, or retroperitoneal gland involvement. The gut above the constriction may be much dilated, and its wall thinned. Rupture above the constriction is possible and we have seen it occur in the cæcum in one of our cases, the result being a huge intra-peritoneal fecal abscess and a fatal issue. In another case a contracting growth in the middle of the transverse colon in which the obstruction had been relieved by an enterostomy in the small intestine, there was absolute water-tight closure of the lumen of the colon at the time of its resection. Bloc resection of the colon with end-to-end suture was followed by spontaneous closure of the fecal opening. Death occurred, however, within a year due to extensive metastases in liver and peritoneum.

When constrictions occur in the ascending colon or cæcum, the lower ileum undergoes hypertrophy and marked dilatation. This often produces the symptom called stiffening of the bowel, or disappearing tumor. The lower ileum goes into a state of tonic contraction similar to that of the gravid uterus; a tense mass formed by the intestinal coils can be seen and felt, and if the hand is kept on the abdomen, in a few moments the spasm relaxes, the gut wall softens and the tumor disappears. This is simply a later phase of the visible peristalsis seen in these cases.

Perforation of the growth itself from deep ulceration, with pericolic abscess formation, occurred in five of our cases; in one the perforation was plugged with an orange seed.

Drainage was done in two cases, a cæcal growth in a woman of seventy-two, and a descending colon growth in a man of forty-four. Simple drainage of the abscess was followed by a fatal result in the cæcal case in twenty-four hours. Drainage of the abscess and cæcostomy by death on the sixth day in the second case. A third case made an operative recovery after drainage of the abscess with a short circuit operation. Two cases died promptly of acute sepsis after radical resection, with contamination of the operative field from the perforation, both left colon cases.

A third type is the massive medullary growth, with early lymph-node

involvement and metastases. These cases grow more rapidly and are prone to hemorrhage. While attempts at radical resection are usually discouraging in this type, one of our cases, a man twenty-nine years of age, the youngest of the series, lived for three years, four months after operation, an extensive right colon resection and had more than two years of active work in comfort, as principal of a large public school. The growth was of the medullary type with colloid formation; lymph-node involvement quite extensive at the time of operation.

We have had 67 cases of carcinoma of the colon on the Second Surgical Division of the Roosevelt Hospital since 1909. Of these 37, or 55 per cent., have been treated by radical resection; 19 right colon growths and 18 left colon. Of the right colon growths 17 were resected by one-stage method with immediate suture; 13 side-to-side; 3 end-to-end; 1 end-to-side.

Fifteen of the seventeen recovered and two died; one recent case, end-to-side suture from obstruction at the site of anastomosis, in spite of a secondary enterostomy; the other after the wound had healed and he was out of bed, on the thirty-third day after operation from cardiac decompensation. The operative mortality of this group was 11.7 per cent., or excluding the cardiac death 5.8 per cent. Two right colon cases were resected by the two-stage method; one recovered and one died.

Of the 18 left colon resections, eight were done by one-stage resection with immediate suture; with 3 deaths, all due to acute sepsis, a mortality of 37.5 per cent. Ten were done by the two-stage method with 3 deaths, a mortality of 30 per cent., two were due to acute sepsis, one to late cerebral metastases. The operative mortality of the series, 37 cases with 9 deaths, was 24.3 per cent.

A study of these statistics illustrate the fact that resection of the left colon is attended by a higher mortality than resection of the right colon, in which a one-stage operation with immediate suture is a relatively safe procedure; that the difference is due to the higher infective potency of the left colon content, a fact long recognized, and also to the greater difficulty of securing healing without leakage in suture of the left colon.

These facts are leading us more and more to resort to the two-stage procedure of Mikulicz in left colon growths, and we believe that this procedure will greatly reduce the mortality in this group, in spite of the fact that the results in the short series quoted do not demonstrate this. The real operative mortality in the ten cases so treated, excluding the late death (seventy-third day) from cerebral metastasis, was 20 per cent. rather than 30 per cent., while the mortality, all due to acute sepsis, of the one-stage method was 37.5 per cent.

Three of our right colon cases had severe secondary anæmia when first seen, with the following blood counts:

Hæmoglobin	35 per cent.	R. B. C.	2,914,000
Hæmoglobin	40 per cent.	R. B. C.	3,368.000
Hæmoglobin	46 per cent.	R. B. C.	4,000,000

All were transfused first, and a one-stage entero-colectomy performed, by lateral suture. All made excellent recoveries and are now well at thirteen years, nine years and three years and ten months, respectively.

Right colon growths, even without gross hemorrhage, are prone to produce advanced degrees of secondary anæmia, with great debility, the exact cause of which is somewhat obscure. They offer in spite of this, some of the best prospects for a radical cure as several cases in our series illustrate.

We quite appreciate that the above results are not brilliant, and must turn to late results for a more hopeful view of the prognosis.

Of the 28 cases which recovered from radical resections, 15 are alive and well at the present time without recurrence; one is alive with recurrence at 4 years 4 months after operation. One was well 6½ years and then lost to our follow-up in 1916; one died 8 years after operation, free from recurrence following an operation for septic cholangitis; one 2½ years post-operative free from recurrence, following an extensive resection for persistent colostomy opening; a remarkable and complicated case to which I will refer later.

Seventeen cases out of twenty-eight therefore are well or died free from recurrence after long periods, 60.7 per cent. One lived 6½ years and was lost track of, raising the percentage to 64. One is alive 4 years, 4 months with recurrence.

Of the other late deaths, one followed 6 months after a second radical resection for local recurrence at the ileocolic junction five years after the first operation. One was well 18 months, developed recurrence and died 3 years, 2 months after the primary operation. Seven died of recurrent disease at from 8 to 18 months after operation.

The cases now alive and well are at the following periods after operation: 15 years—one; 13 years—two; 9 years—one; 4 years—three; 2½–3 years—two; 1 year, 10 months—one; 1 year, 5 months—one; 7 months—one; less than 4 months—three.

It is the study of these late results which gives the grain of comfort in the study of cancers of the colon; results which compare very favorably with the results of cancer removal in other parts of the body.

Some of the individual cases present features worthy of mention.

A man seventy-five years of age with a large carcinoma at the splenic flexure and commencing obstruction was resected by the two-stage Mikulicz method, made a good recovery and is now well and free from recurrence at 1 year, 10 months post-operative. He spent all last summer travelling in Europe. Nineteen years before operation a carcinoma of the sigmoid had been resected successfully by another surgeon, and the sigmoid and lower descending colon were entirely free from recurrent growth.

A woman of sixty-five years was operated upon for a transverse colon growth quite adherent posteriorly to a retroperitoneal mass of glands, and thought to be inoperable. A short circuit operation was done between transverse colon distal to the tumor and the ascending colon. Leakage occurred and a wide open fecal fistula developed. After a period of three weeks in which death was expected at any hour she began to improve; later an evaginated protrusion of gut, bearing at its apex a round ulcer type of carcinoma appeared in the fistula and finally protruded so far that the growth with a good length of telescoped gut was cut off; and the ends sutured together. Recovery followed but

the fecal opening persisted, 2½ years later after insistent demands on the part of the patient, extensive resection was done for cure of the fistula, followed by death from peritonitis on the sixth day. There was no recurrence of the disease. The retroperitoneal invasion noted at the primary operation was evidently an inflammatory mass. This instructive and disappointing case illustrates the well-known fact that adjacent infiltration and gland involvement associated with ulcerated growths, may be inflammatory and not malignant.

SUMMARY

1. Cancer of the colon excluding the rectum offers a relatively high rate of operability, and a percentage of radical cures which compares favorably with that of malignant disease in other organs.

2. Growths of the cæcum, and right colon, including the right part of the transverse colon, are suitable for a one-stage resection with immediate anastomosis by suture. The operative mortality should be relatively low.

3. Left colon growths are more safely resected by the two-stage Mikulicz method.

MULTIPLE PRIMARY MALIGNANT FOCI IN CANCER OF THE COLON*

By Robert T. Miller, Jr., M.D.

of Baltimore, Md.

From the Surgical Department of the Johns Hopkins University and Hospital

During a recent study of cancer of the colon carried on in the laboratory of surgical pathology in the Johns Hopkins Hospital, which was reported last spring to this association, there were encountered certain cases of multiple cancers of the intestine. Two of these, with possibly a third, appear to be instances of the development of two or more primary cancers in one individual; two other cases are probably examples of recurrence but with so great a period of time elapsing between the first and second tumors as to introduce an element of uncertainty. The subject has proved of sufficient interest to warrant a brief communication, which is made, be it said, with full realization of the extreme difficulty, often the utter impossibility, of determining convincingly the exact status of any case in this category. In view of the general and well-founded clinical conception of cancer as a condition arising from a single focus of origin but acquiring multiple secondary foci of development, the burden of proof is indeed upon one who assumes a case to illustrate multiplicity of primary malignant tumors, and there are so many possibilities of error in observation and interpretation that one necessarily approaches this subject with extreme reserve.

Five of the 129 cases previously studied form the basis of this report:

Case I.—S. N., 16588. A white man, aged forty-nine years, was admitted to the Johns Hopkins Hospital, having had for six weeks intermittent colicky pain, and for four weeks a palpable abdominal mass. He had lost forty pounds in weight. Upon exploration there was found an inoperable carcinoma of the cæcum, and an anastomosis was made between the ileum and transverse colon. Symptoms of obstruction persisting, a second exploration was made four days later and revealed a stenosing carcinoma of the sigmoid. Colostomy was without avail, and the patient died following this operation. At autopsy there were found: (1) a large cancer completely encircling the ileum and extending into the lumen so as to produce marked obstruction; (2) a second similar tumor at the cæcum involving the ileocæcal valve and extending around the lumen of the large intestine. This growth was surrounded by a number of polypoid masses and extended deeply into the mesentery; (3) a third tumor, evidently cancerous, surrounding the bowel at the sigmoid flexure. Microscopic examination showed the tumors of the ileum and of the cæcum to be adenocarcinomata of similar histological appearance, both showing a pronounced tendency to invade. The muscular coats had been broken through and the subperitoneal fat invaded; a small lymph-gland lying in the mesentery just below one of the tumors was involved, but otherwise the lymph-glands were negative. The growth of the sigmoid was rather more papillomatous in type, there being practically no invasion of the muscle. The glandular arrangement was preserved throughout this tumor, in some places the alveoli being lined by a single layer of cells and in other places by multiple layers of cells.

* Read before the American Surgical Association, April 17, 1924.

This case was discussed briefly in 1904 by Bunting,[2] who remarked that "the author leans toward the view in this case that the foci are independent primary foci." (Figs. 1 and 2.)

CASE II.—S. P. N., 14328. A white man, aged forty-three years, presented a history of constipation for many years, for one year a definite change in the stools and a loss of twenty pounds in weight. Examination disclosed a carcinoma of the rectum 12 cm. from the anal margin. This growth was removed and proved to be a typical adenocarcinoma, with infiltration through the wall of the bowel towards the fat in the hollow of the sacrum. No involved lymph-glands were found. Eight years later the patient suffered an acute intestinal obstruction, and at operation there were found two discrete carcinomata, one in the hepatic flexure and the other in the right part of the transverse colon. That portion of the intestine bearing the growths was successfully resected, the patient dying three months later from an unrelated cause. Pathological examination showed one of this pair of cancers to be typical adenocarcinoma, with marked tendency to form glandular acini, while the other presented a marked histological resemblance to squamous-celled cancer though here and there preserving a slight but definite tendency toward an alveolar arrangement. There were metastases to the lymph-glands at the hepatic flexure. (Figs. 3, 4, 5, 6 and 7.)

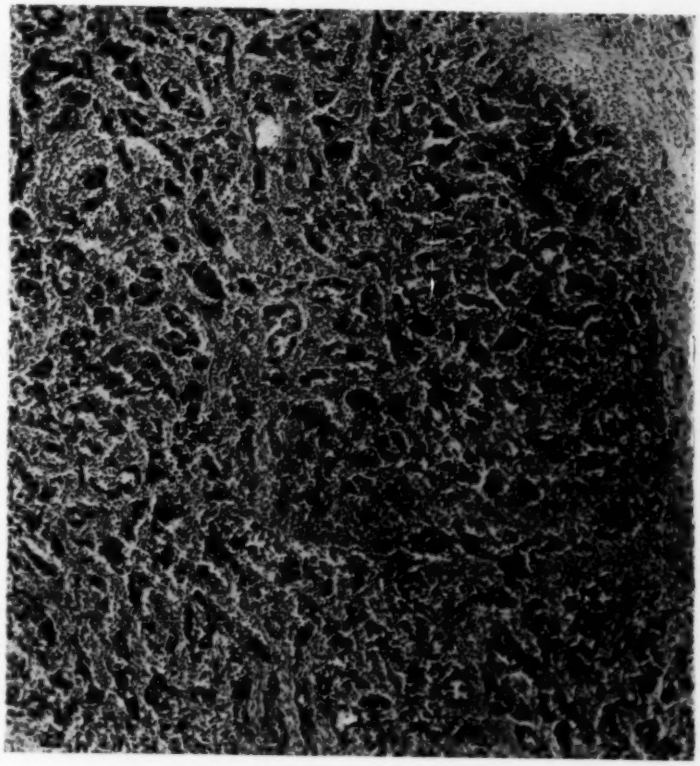


FIG. 1.—S. N. 16588. Microphotograph of cancer of ileum.

CASE III.—S. P. N., 15059. A white man, aged seventy-two years, on the fourth day of an acute obstruction submitted to cæcostomy, dying 36 hours later. At autopsy there were found two annular carcinomata, one at either foot point of the sigmoid. The upper tumor, which was confined to the wall of the bowel, presents so characteristic a histological picture of adenocarcinoma that it could well typify the large majority of cancers of the colon; the lower tumor, which had invaded the mesentery and become adherent to the bladder, presents quite a different picture. It has invaded the muscular coats deeply, and the epithelial cells are throughout closely packed together with very little tendency to take a glandular arrangement. Here and there one recognizes a group of cells with a somewhat alveolar arrangement but in the main this has been lost, even in the advancing edge of the tumor which one sees just beneath the normal mucosa. The lower tumor is apparently

somewhat older than its fellow, which is still contained by the muscular coats of the bowel. There are quite marked differences in the histological appearance of the two tumors, and these differences are not readily explained as representing different stages of growth in identical tumors. Both tumors have evidently started in the mucosa; neither represents secondary involvement of the mucosa by extension from a subperitoneal or mesenteric metastasis of the other tumor. These three points are important evidence bearing directly upon the question of multiple primary cancers. (Figs. 8, 9, 10, 11 and 12.)

CASE IV.—S. P. N., 15001. A white man, aged sixty-two years, on the seventh day of an acute intestinal obstruction submitted to cæcostomy. Three months later a cancer of the sigmoid was resected, and on examination found to be a rather fibrous type of adenocarcinoma producing stricture of the gut. The lymphatic glands were invaded. The patient died seven years later with the clinical signs of cancer of the cæcum involving the abdominal wall at the site of the cæcostomy. Unfortunately no autopsy was made. (Figs. 13 and 14.)

FIG. 2.—S. N. 16588. Microphotograph of cancer of cæcum.

CASE V.—S. P. N., 6595. A white woman, aged thirty-eight years, submitted to exploration because of suspicious symptoms; there was found a carcinoma of the cæcum which was successfully resected. Sixteen years later the patient died; a diagnosis of cancer of the liver, though not verified by autopsy, seemed quite secure.

These five cases represent a variety of conditions, but there is common to them all the fact of multiple cancers, which in each instance occur in such fashion as to throw open to reasonable doubt the assumption of a single primary tumor as the sole point of origin of the disease. Such doubt may be aroused by the presence in the intestine of several cancerous foci among which there is great similarity in size, extent of invasion, and apparent age. A similar suspicion is aroused by the occurrence of two or more cancers widely separated by an intervening length of healthy gut, particularly when the aboral tumor appears to be the oldest of the group; if several years intervene between the various tumors and the aboral member of the group is unmistakably the oldest, as in the second instance presented above, the con-

clusion as to multiplicity can scarcely be avoided. Marked histological differences between the various tumors is difficult to explain other than by their independent origins. The question of recurrence or a second independent tumor is usually open and has provoked much argument; under certain conditions, as marked delay in the appearance of the second tumor, we cannot hope to arrive at entirely definite conclusions since either is a possibility and we lack reliable criteria. Thus the question of multiplicity is raised by each of the five cases and its discussion, even though inconclusive, is not entirely devoid of interest.

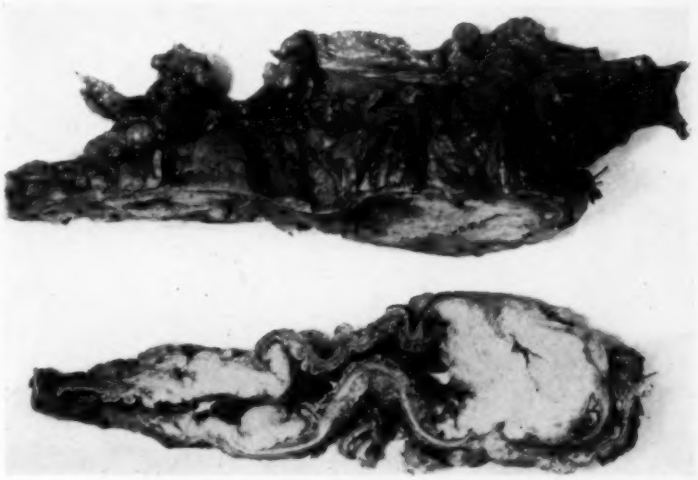


FIG. 3.—S. P. N. 14328. Cancer-bearing sector of colon which was removed at second operation.

FIG. 4.—S. P. N. 14328. Low power microphotograph of the adenocarcinoma. A small portion of normal mucosa is seen at the right end of the section.

The regularity with which cancerous disease takes its origin from a single parent tumor has been so borne in upon us that the occurrence of a case suggesting multiplicity of origin excites a definite interest. The condition has been recognized for many years. Billroth is commonly credited with the first case report, which appeared in his Manual of General Surgical Pathology in 1860 and told of a cancer of the stomach found in a man from whom an epithelioma of the external ear

had been previously removed. Mercanton [3] states that Rokitansky in 1855 and Von Bruns in 1859 both mention the condition and that between 1863 and 1889 the subject was considered by a number of men, among whom are Virchow, Volkmann, Tillmann, and Schimmelbusch. The early reports usually considered multiple cancers of the skin, and it was more or less through the development of this theme that attention was directed toward the other forms of multiplicity. It is probable that multiple primary carcinomatous foci of the skin are associated in the minds of most clinicians with the dry senile type of eczema and with X-ray dermatitis, but a number of other conditions are mentioned in the same connection, as paraffin and tar cancer, chimney sweeper's cancer of Percival Pott, arsenic cancer, in which a period of pachydermia precedes the development of malignant foci, and the epitheliomata which develop in tissue changed by lupus or psoriasis. v. Hansemann [4] emphasizes his belief that only those forms of skin cancer are regularly multiple which are preceded by an inflammatory affection of the skin. With increasing knowledge it became evident that the many examples found in the skin could be conveniently considered together, thus forming one of the clinical groups rather generally adopted at present, *viz.:* primary multiplicity affecting a single organ, the skin and the gastro-intestinal tract being typical examples. Besides this group, there are to-day usually recognized two others, *viz.:* primary multiplicity affecting paired organs, and primary multiplicity in which the sites of the several tumors are unrelated. There are many examples of each of these groups.

FIG. 5.—S. P. N. 14328. High power microphotograph of the adenocarcinoma showing the preservation of the glandular arrangement.

When two or more carcinomata appear simultaneously it may be less

difficult to determine their independence of each other than when these tumors appear at intervals of several years, since in the second instance one must distinguish between recurrence and new growth. Distinct histological differences between the two tumors are usually accepted as establishing independence, but it does not necessarily follow that histological similarity means one parent tumor from which the others have sprung; multiple independent carcinomata of the colon developing on a groundwork of polyposis serve well as an illustration. A few years ago a patient sought examination because of a tiny "lump" in the right breast. The suspicious area was so very small that diagnosis other than by microscopic study could not be made, and since there seemed little or no chance of the mass being malignant it was excised under local anæsthesia. The mass proved to be carcinomatous and radical operation was promptly made. Careful study of the breast in the laboratory revealed a second malignant focus, smaller even than the first, from which it was separated by a wide area of normal breast. The patient has remained well. Such a case is surely an instance of simultaneous origin of multiple primary malignant foci. For the purpose of argument, however, let us suppose that with the little mass removed nothing more had been done until the second independent cancer, left undisturbed, had grown large enough to be recognized as carcinoma of the breast; under these conditions a clinical diagnosis of recurrent cancer would have been accepted without question. Ellsworth Eliot [5] has discussed this subject recently and presented a number of interesting cases. Ewing,[6] in discussing the influence exerted by tumors upon surrounding tissues as a source of recurrence of the growth, remarks that this question is closely related "to that of the multiple origin of tumors in the same organ."

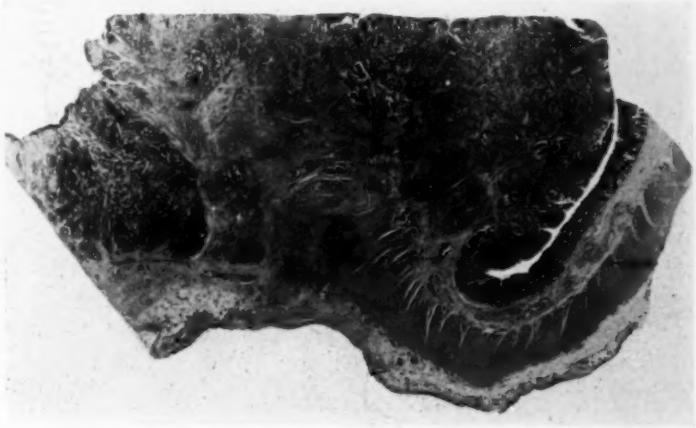


FIG. 6.—S. P. N. 14328. Low power microphotograph of the smaller more solid tumor. Normal mucosa is visible towards the right end of the section. Note the striking difference between this tumor and its companion tumor, Fig. 4.

In the study of this condition, therefore, one must consider the time as well as the site of occurrence. Theilhaber [7] states that in point of frequency of occurrence the condition of multiple primary carcinomata takes the following order, *viz.*: (1) local disease which affects one system only, as the

gastro-intestinal tract, and usually but a part of that, as the colon; (2) disease of similar paired organs; (3) synchronous widely separated foci of disease; and (4) widely separated foci of disease appearing at reasonably long intervals.

Early in the study of these cases Billroth formulated three conditions which he thought must be fulfilled by multiple cancers before the different tumors can be considered independent of each other; namely: (1) the two growths must show distinct histological differences and these must be so pronounced as to exclude their interpretation as merely different stages of development; (2) each growth must spring from its parent epithelium; (3) each growth must have its own group of metastases. Mercanton attributes these criteria to Michelsohn and Küster, but he apparently is alone in failing to credit them to Billroth. It is obvious that simultaneous tumors which fulfil each of these three conditions would have very strong evidence of their independence of each other. Mercanton adds a fourth condition to the effect that if, after the removal at one operation of two cancers, the patient remains free from disease, it is practically certain that the two growths were independent, since had either been a metastasis it would be entirely reasonable to assume the presence of other metastases, a state of affairs incompatible with life. This fourth condition appears sound and is applicable particularly to multiple cancer of the colon and similar examples where the growths are confined to one relatively small organ. There are apparently unquestioned instances of multiple primary cancers of the colon, and it is evident that such

FIG. 7.—S. P. N. 14328. High power microphotograph of tumor shown in Fig. 6. Note the great difference between this section and Fig. 5, its companion tumor.

a case may not fulfill Billroth's three conditions; Bunting is of the opinion that these criteria were obviously intended to apply to carcinomata arising in different organs. Surely any group of simultaneous lesions which fulfill all of these conditions would be beyond doubt. Indeed it seems quite safe to accept certain cases which fail to meet all of them. Arbitrary insistence is unreasonable; common sense recognizes, probably without argument, the primary multiplicity of adenocarcinomata of the colon which starts in polyps. There is much in the literature indicating that a colon which is the site of multiple polyps is prone to present cancerous changes in certain of them, so that whether these tumors appear sumultaneously or, as in our second case, spaced by several years, one can hardly doubt the nature of the condition. Figure 15 shows this not infrequent finding, *viz.*: cancer and polyp in close association. (Figs. 15, 16, 17.) In the gastro-intestinal tract, however, there are a num-

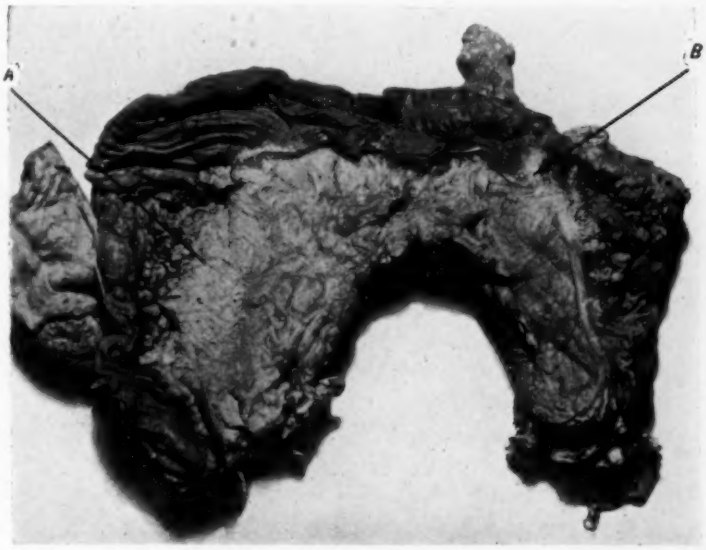


FIG. 8.—S. P. N. 15059. Longitudinal section through the sigmoid loop and its mesentery. The mucosa is shown above and the mesentery below. Two cancers present in the lumen of the bowel, that at A being the larger tumor and preserving its adenocarcinomatous structure, that at B being a smaller and more fibrous tumor.

FIG. 9.—S. P. N. 15059. Low power microphotograph of tumor A.

ber of ways in which a secondary dependent growth may become established, so that our problem is often very difficult. We recognize metastasis by the lymphatics; commonly we think of this as occurring by a path leading directly and consistently away from the tumor, but there is always the possibility of metastasis by retrograde or other circuitous routes. It may be a matter of the utmost difficulty, indeed impossible, to assert concerning two cancers of the gastrointestinal tract that each is a primary neoplastic unit quite independent of its companion tumor. Our case of double cancer of the sigmoid presents just this problem. This patient was brought to the hospital in acute obstruction of the sudden unheralded type. Colostomy failed to rescue the patient, and at autopsy there were found two cancers, one at either foot point of the sigmoid. One was confined to the wall of the bowel, the other had begun to penetrate it. The growths were not in contact nor were there any visible lymphatic strands connecting them; they were approximately of the same size, from which one may infer their approximately equal length of life. Under these circumstances there exists at least the possibility of their simultaneous development. It is similarly possible, however, that lymphatic metastasis has occurred by way of the mesentery, travelling first upward to its root, and then, perhaps because continued progress was blocked in this direction, down to the other foot point of the sigmoid. Had this occurred early in the disease the final picture might simulate double primary cancer closely. Were a case such as this to fulfill the three conditions of Billroth one would be inclined to accept the primary multiplicity of the carcinomata as proved; it must be recognized, however, that failure to meet the conditions does not necessarily throw the case out. The possibility

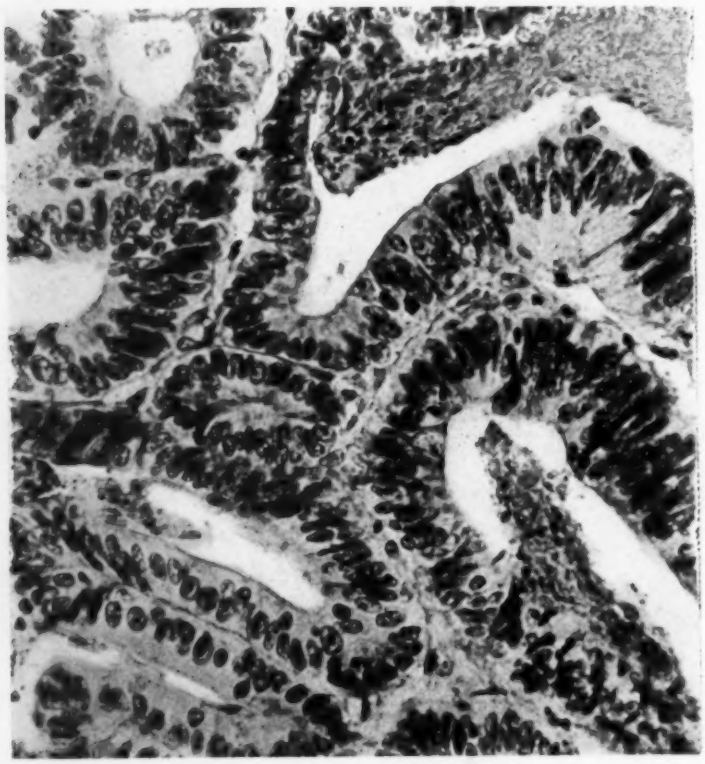


FIG. 10.—S. P. N. 15059. High power microphotograph of tumor A. Note the preservation of the glandular arrangement.

of the occurrence of primary multiple carcinomata which do not fulfill Billroth's conditions cannot be denied.

We recognize the occasional transmission of cancer also by the blood stream, it even being held that retrograde venous embolism may occur. There is also the establishment of a second cancerous focus through contact; certain cases in the literature illustrate the transmission of cancer from one to the other lip or from the tongue to the cheek. In the gastro-intestinal tract this condition usually brings about the adherence of one organ to the other, the final appearance being that of direct extension of cancer in continuity. Dissemination through the escape of cancerous cells which float off in the peritoneal fluid is well recognized. Such secondary growths are frequently found in the pelvic parietal peritoneum, and their occurrence is not infrequent upon the visceral peritoneum, particularly of the omentum and the mesentery. We assume this to be a late phenomenon resulting usually in a multitude of small obviously secondary growths, so that simulation of but two or three primary carcinomata could hardly result.

FIG. 11.—S. P. N. 15059. Low power microphotograph of tumor B.

There is an implantation type of cancer in the gastro-intestinal tract which is of very considerable interest. Indeed, this mode of transmission is usually held to account satisfactorily for multiple carcinomata presenting in the lumen, and is so obvious that it is difficult to avoid its acceptance when the growths are of similar histological type and so situated as to indicate that the aboral member is the youngest of the group. However, when a prolonged period of time separates the appearance of the two tumors and the second lies orally with reference to the first, as is illustrated in the second of the cases cited above, implantation or engrafted cancer fails to explain the situation satisfactorily. A striking example of implantation cancer of the gastro-intestinal tract is reported by L. Hoche [8] in La Presse médicale of 1901 and is of sufficient interest to warrant its statement in detail.

A man of seventy-five years died from cachexia twelve hours after admission to the hospital. At autopsy there was found an epithelioma of the œsophagus 4 x 2.5 cm., situated 5 cm. above the bifurcation of the trachea. The lesser curvature of the stomach was adherent to the pancreas, and upon opening the stomach there was found in this situation a chronic ulcer the size of a two-franc piece. On the base of the ulcer was a hard nodule which was not in contact with the epithelial edge of the ulcer at any point and which, though more or less imbedded in the pancreas, was quite distinct from it. Histologically the nodule proved to be a discrete, sharply outlined cancerous mass which did not invade the pancreas. The base of the ulcer was otherwise composed of granulation tissue, and its epithelial edges showed nothing more than simple inflammation. The pancreas likewise showed only simple inflammatory changes. The lesion was apparently a simple ulcer in whose centre there had developed a cancer which entirely lacked contact with normal epithelium at any point. The growth in the œsophagus (Fig. 18)† was found to be a typical squamous epithelioma whose histological picture was duplicated by the carcinomatous nodule in the base of the ulcer (Fig. 19).† Nothing was found to suggest the usual adenocarcinoma of the stomach. No other cancerous lesions were found.

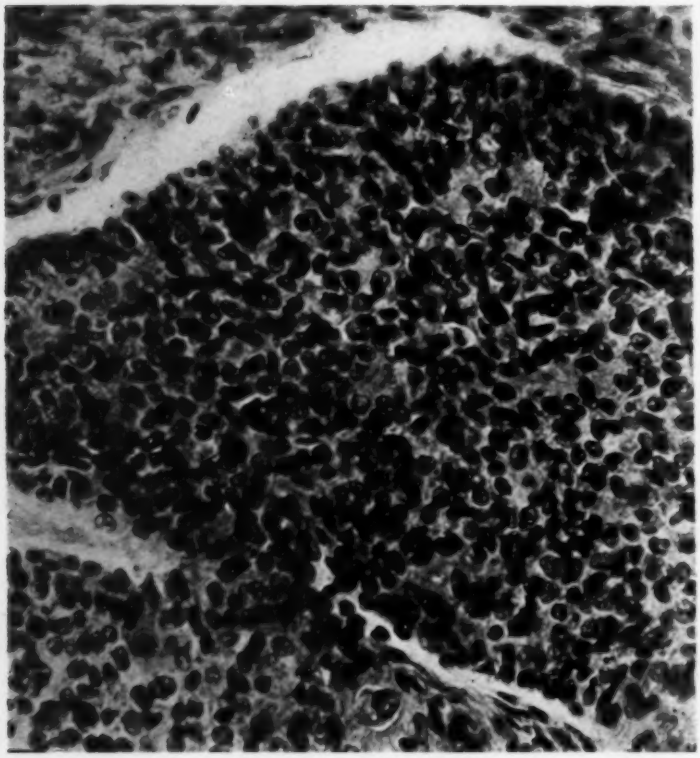


FIG. 12.—S. P. N. 15059. High power microphotograph of tumor B. Note the closely packed epithelial cells, strongly suggesting squamous cell cancer. There is a striking difference in appearance between this tumor and that shown in Fig. 10.

Another interesting example of engrafting of cancer was reported by Chalier[9] in 1909. A man of forty-three came to autopsy some months after an anastomosis between the ileum and the transverse colon had been made to relieve him of partial obstruction due to a cancer of the cæcum. There were found (1) in the ileum 10 cm. from its termination three or four submucous nodules as large as a small chestnut, (2) in the cæcum an ulcerating cancer of the ileocæcal valve, (3) a stenosing cancer at the junction of cæcum and ascending colon, and (4) in the transverse colon thick sclerotic cancerous tissue surrounding the anastomosis. Histologically the growths were all colloid cancer. Chalier remarks that the growth in the transverse colon is definitely an implanted

† Reproduced from article by Hoche in La Presse médicale, 1901, vol. i, pp. 67–69.

cancer since it occurs in tissues which were quite healthy at time of operation but which suffered both operative trauma and the scarring incident to healing. One can well imagine that implantation occurred upon some granulating area before the healing process had been completed. Dowden[10] in 1917 Reported a case of much the same sort. The patient was a woman of sixty years who submitted to three operations: (1) resection of a cancer of the sigmoid, followed in three years by (2) colostomy for cancer of the rectum, and at the end of a year (3) resection of a cancer of the small bowel. A few months after the final operation cancer appeared at the colostomy wound. Dowden believed the disease to have been primary in the ileum. Recurrence or the development of a second cancer in the traumatized tissue of an old colostomy is shown in our case Number 4; here, however, there can hardly have been a question of implantation since the first tumor was in the sigmoid and the second in the cæcum. Christian Fenger[11] in 1888 reported a case which may be in-

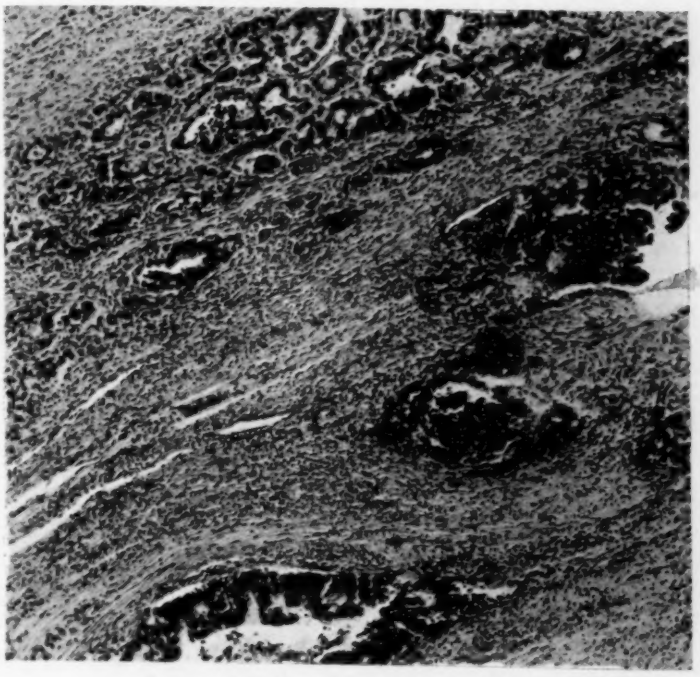


FIG. 13.—S. P. N. 15001. Cancer of the sigmoid.

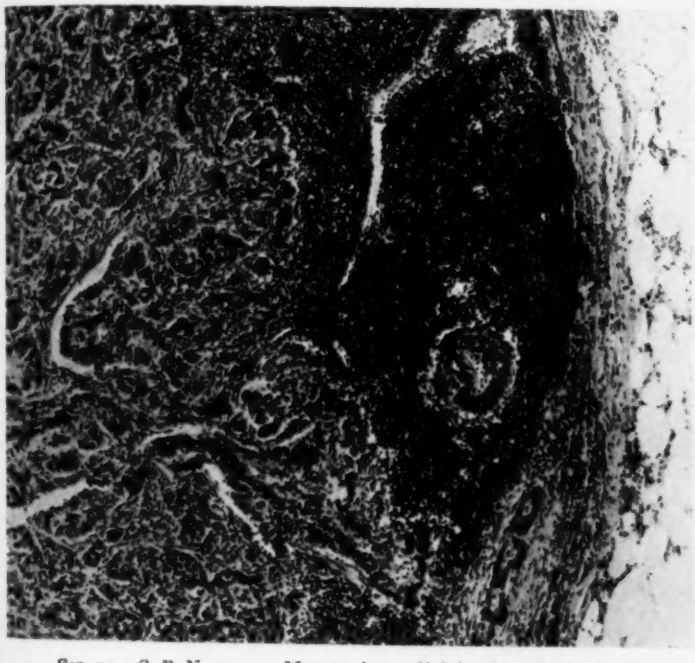


FIG. 14.—S. P. N. 15001. Metastasis to adjoining lymphatic glands.

terpreted as double primary cancer of the colon or as an example of implantation. It concerns a man of about forty-five upon whom an anastomosis between the ileum and the transverse colon was made for cancer of the ascending colon. At autopsy made ten days later there was found a cancer of the ascending colon, producing complete obstruction, and a second cancer of the splenic flexure, causing marked stenosis.

FIG. 15.—S. P. N. 27377. The cæcum has been opened to show the mucous surface. There is seen a large adenocarcinoma at whose edge (to the right) is situated a benign polyp.

There appears to be no doubt as to the occurrence of implantation cancer of the mucous surface of the gut, and of all the forms of secondary growth, apparently cancer so produced may most clearly simulate primary cancer. This is particularly true when the growths are limited to a small section of the gut, as for instance the colon. Practically all cancers of the colon, whether primary or secondary, are assumed to preserve an adenocarcinomatous structure in a more or less marked form, so that a widely different histological appearance in the two growths is not

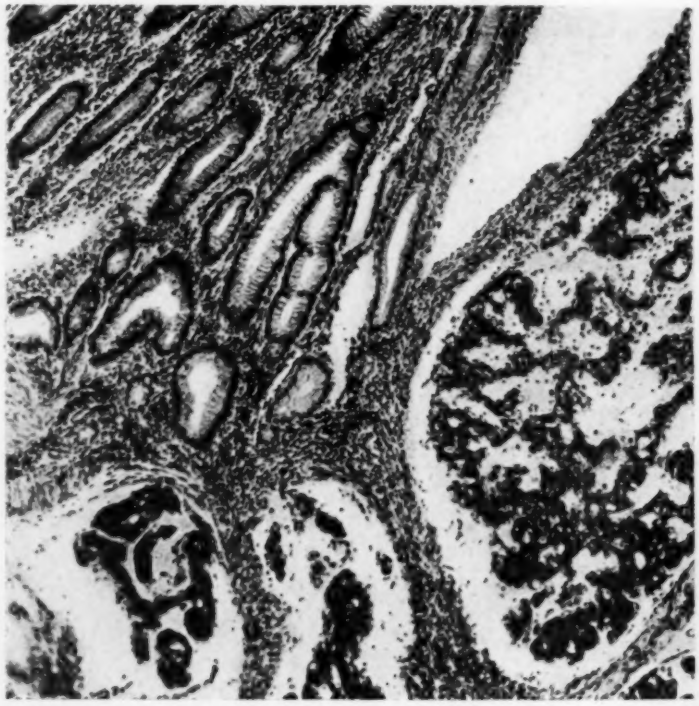


FIG. 16.—S. P. N. 27377. Microphotograph of adenocarcinoma in Fig. 15.

expected. They all spring from epithelium of the same type—the mucosa of the large gut—and in general all would tend to produce metastases of the same type, though in different situations.

A much more fundamental question, indeed, has been raised from time to time as to whether the lesion diagnosed clinically as cancer has in fact started in and grown from one centre or whether its unity does not rather mean that since the process started, enough time has elapsed to allow coalescence by growth of multiple centres of origin, thus converting actual multicentric growth into apparent unicentric growth. This carries the question beyond the limits of clinical study; diagnoses from physical signs cannot be made in such early stages of disease.

FIG. 17.—S. P. N. 27377. Microphotograph of benign polyp in Fig. 15.

The foregoing discussion makes no pretense of attempting more than a brief résumé of the subject together with the presentation of several cases which illustrate certain aspects of the problems of the genesis and the growth of cancer. Although the matter appears to be largely of speculative interest, its consideration nevertheless brings out certain facts of some importance in the management of cancer of the colon. It must be recognized that there occur certain rare cases in which cancer of the colon starts in two or more primary foci. The terminal ileum is not uncommonly associated with the colon in this type of disease. Exploration of the ileum and entire colon should therefore be a routine step in the operative treatment; experienced surgeons have closed the abdomen without suspecting the presence of the second tumor. A growth of the splenic flexure is peculiarly elusive.

By a process of implantation secondary cancers may be engrafted on the mucous surface of the colon or elsewhere in the gastro-intestinal tract, and

it appears that traumatized tissue is an especially fertile bed for this development; such an occurrence is not rare and may result in a condition offering the same surgical problems as multiple primary tumors. Adenocarcinoma, the common type of cancer of the colon, seems especially apt to develop secondary implantation growths.

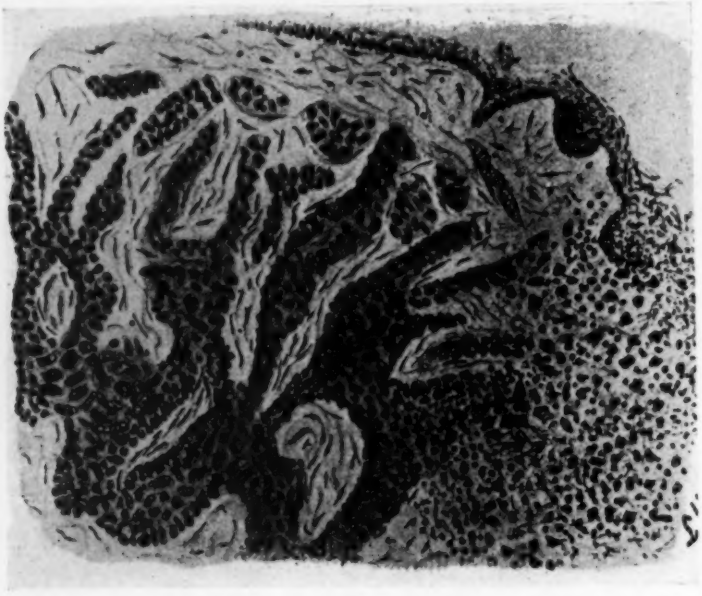


FIG. 18.—Section taken on the edge of the ulcerated tumor of the œsophagus. (Reproduced from article by Hoche.)

Clinical experience and many reports in the literature make it plain that carcinoma is prone to develop in the mucosa of a polyp of the colon. There are numerous records of the association of polyposis and cancer; there may be found a cancer and a polyp side by side, as pictured above, or in a colon bearing numerous polyps there may be found two or more cancers apparently of approximately the same age. In the literature there are reports of cases, like our second case, in which two or more cancers develop one after the other and separated by intervals of several years. The

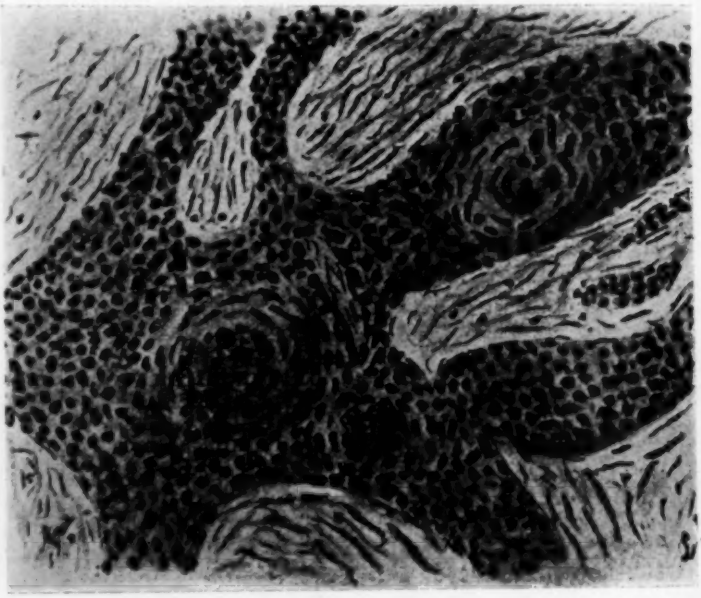


FIG. 19.—Section taken in the neighborhood of the base of the gastric ulcer. (Reproduced from article by Hoche.)

first tumor is apt to be in the lower colon and the others to occupy sites progressively higher, which excludes the possibility of implantation. The time interval between the appearance of the tumors is too long to encourage their interpretation as delayed recurrences even were their sites of development to favor this explanation. The tumors start on the mucosal surface and frequently do not penetrate the bowel wall deeply, which excludes metastasis by the blood or lymph stream or peritoneal fluid. Finally, in such a colon polyps are very apt to be found, and their known tendency to carcinomatous change seems to offer adequate explanation of the circumstances of such a case.

Appreciation of the surgical problems of polyposis of the colon is, then, of very considerable importance to the surgeon. This matter has been discussed more or less in the literature, but recognition of the cancer tendency in polyposis of the colon is of relatively recent date. The subject has been discussed by Babler, Niebruegge, and Fisch,[12] Lilienthal,[13] Lockhart-Mummery,[14] Bardenheuer,[15] Back,[16] and Forster.[17] It is a benign condition with definite carcinomatous tendencies—in other words, a clear precancerous lesion—and this fact will perhaps largely determine our final position with reference to treatment. At present there is no generally accepted plan and the suggestions have ranged from simple excision of the polyps to complete colectomy, which, radical though it seems to-day, may yet come into quite general usage. This subject would well repay careful study.

In a practical sense, then, we must recognize that cancer of the colon may occur as multiple primary lesions, that an entirely similar picture may be produced by tumors which develop secondarily, and that polyposis of the colon has a very definite tendency to malignant degeneration.

BIBLIOGRAPHY

[1] Miller, R. T., Jr.: Cancer of the Colon. Trans. Amer. Surg. Assoc., 1923, vol. xli, pp. 54–76.

[2] Bunting, C. H.: Multiple Primary Carcinomata of the Ileum. Johns Hopkins Hosp. Bull., 1904, vol. xv, pp. 389–394.

[3] Mercanton, F.: Des carcinomes primaires multiples. Thèse de Lausanne, 1893.

[4] v. Hansemann: Das gleichzeitige Vorkommen verschiedenartiger Geschwülste bei derselben Person. Zeitschr. f. Krebsforsch., 1904, vol. i, pp. 183–198.

[5] Eliot, E., Jr.: Recurrence versus Metastasis in Carcinoma. Trans. Amer. Surg. Assoc., 1922, vol. xl, pp. 115–120.

[6] Ewing, J.: Neoplastic Diseases. Phila. and London, 1919, p. 88.

[7] Theilhaber, A., and Edelberg, H.: Zur Lehre der Multiplizität der Tumoren, insbesondere der Carcinome. Deutsche. Zeitsch. f. Chir., 1912, vol. cxvii, pp. 457–489.

[8] Hoche, L.: Du cancer gastrique secondaire. La Presse méd., 1901, vol. i, pp. 67–69.

[9] Chalier, A.: Cancers multiples du segment iléo-coecal, en ayant imposé à l'opération et même à l'autopsie pour une tuberculose sténosante et hypertrophique de l'intestin. Lyon méd., 1909, vol. cxiii, pp. 736–739.

[10] Dowden, J. W.: Carcinoma of Pelvic Colon: Resection. Three years later, recurrence in rectum: colostomy. One year later, carcinomatous stricture, small intestine: resection. Carcinoma at colostomy opening: death six years after first operation. Edinb. M. J., 1917, n. s. vol. xix, pp. 181–183.

[11] Fenger, C.: Double Carcinoma of the Colon. Report before the Gynæcological Society of Chicago, June 29, 1888. Jour. Amer. Med. Assoc., 1888, vol. xi, pp. 606–607.

[13] Babler, E. A., Niebruegge, H. J., and Fisch, C.: Carcinomatous Polyposis of the Colon, with Report of an Interesting Case. Jour. Amer. Med. Assoc., 1909, vol. lii, pp. 1235–1239.

[13] Lilienthal, H.: "Cancer Tendency" in Large Intestine. Carcinoma of Colon. A case occurring nearly twenty years after extirpation of a similar tumor. Med. Times, New York, 1915, vol. xliii, p. 223.

[14] Lockhart-Mummery, J. P.: Diseases of the Colon. Bristol, 1910, pp. 252–253.
Discussion of Case of Multiple Polypi of Rectum and Colon, by L. E. C. Norbury. Proc. Roy. Soc. Med., Lond., 1913–14, vol. vii, pt. 3, Sect. Surg., p. 196.

[15] Bardenheuer, F.: Eine seltene Form von multiplen Drüsenwucherungen der gesammten Dickdarm- und Rectalschleimhaut neben Carcinoma recti. Arch. f. klin. Chir., 1890, vol. xli, pp. 887–901.

[16] Back, I.: Case and Specimen of Multiple Polypi of the Colon Becoming Carcinomatous. Proc. Roy. Soc. Med., Lond., 1913–14, vol. vii, pt. 3, Surg. Sect., p. 193.

[17] Forster, E. R.: Rapport sur deux cases d'adéno-papillomes multiples du gros intestin avec carcinoma cylindrique concomitant. Revue méd. de la Suisse Roman., 1903, vol. xxiii, pp. 562–570.

RÖNTGENOLOGICAL VISUALIZATION OF THE GALL-BLADDER BY THE INTRAVENOUS INJECTION OF TETRABROMPHENOLPHTHALEIN*

By Evarts A. Graham, M.D., Warren H. Cole, M.D.
and
Glover H. Copher, M.D.
of Saint Louis, Mo.
From the Department of Surgery, Washington University School of Medicine and Barnes Hospital

In a previous publication [1] we called attention to the fact that the calcium salt of tetrabromphenolphthalein when injected intravenously permits the visualization of the gall-bladder with the Röntgen-ray. Earlier animal experiments which had been made with the sodium salt resulted in shadows which were not so satisfactory as the ones obtained later with the calcium salt. There were certain objections, however, to the use of the calcium salt, chief of which was that, owing to its relative insolubility, it was necessary to inject a large amount of fluid in order to give the required amount of the substance. In many cases also it was found that unpleasant effects were produced, such as dizziness, headache, nausea and vomiting. Chiefly because of a desire to get away from the unpleasant effects of the injection, we have more recently returned to the use of the more soluble sodium salt.[2] We have learned furthermore that at least one of the reasons for the unsatisfactory nature of the shadows which were formerly obtained with this salt was due to the fact that in the experimental animals we at first did not appreciate the importance of having the stomach empty at the time of injection. By exercising this

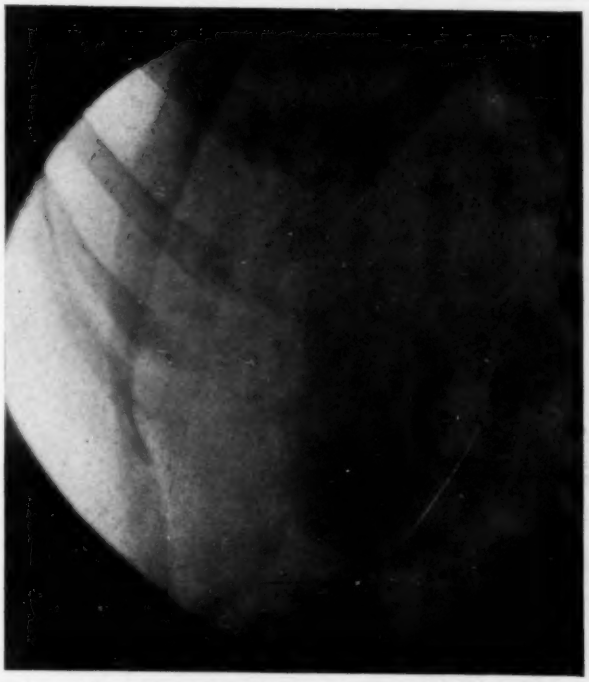


Fig. 1.—The shadow of the gall-bladder appearing faintly seven and one-half hours after the injection.

* Read before the American Surgical Association, April 17, 1924.

[1] Graham, E. A., and Cole, W. H.: Röntgenologic Examination of the Gall-bladder, Jour. A. M. A., 1924, vol. lxxxii, p. 613 (Feb., 23).

[2] A crystalline sodium salt of tetrabromphenolphthalein has been prepared and can now be obtained from the Mallinckrodt Chemical Works, Saint Louis.

simple precaution we have now found that shadows may be obtained with the relatively soluble sodium salt which are just as satisfactory as those formerly obtained with the less soluble calcium salt. The presence of calcium, therefore, seems to be of no particular value. The additional advantage is also present that, instead of the necessity of using about 325 c.c. of fluid, as was the case with the calcium salt, in order to give the usual dose of 5 or 5.5 grams of the salt, it is necessary to use only about 35 or 40 c.c. of water to effect the solution of the 5 or 5.5 grams of the sodium salt. The unpleasant symptoms following the injection have also been greatly diminished as a result of the use of the smaller amount of fluid injected. For these reasons, therefore, we are now using the sodium salt exclusively.

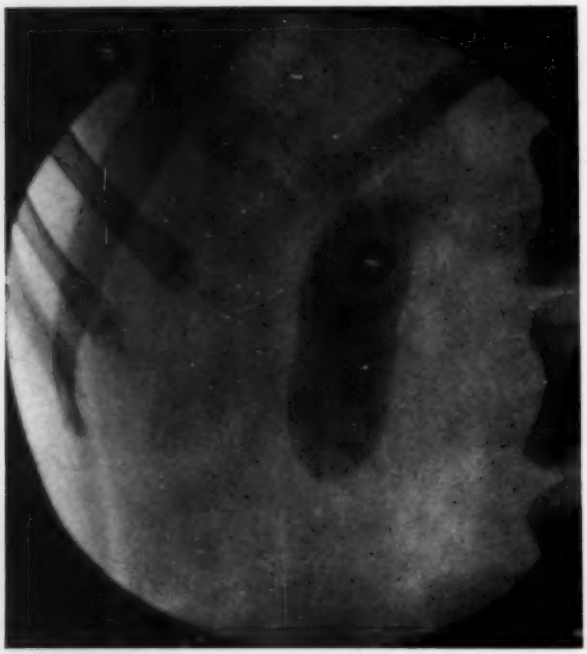


FIG. 2.—The same after 24 hours. The shadow has become much more distinct and the gall-bladder is much smaller. The contour is regular.

It is hoped that the method of visualization of the gall-bladder described here may have a distinct clinical value in the diagnosis of certain cases presenting abnormalities of the biliary tract which would otherwise be obscure, in a manner analogous to the revolutionary effect of the opaque meal in the diagnosis of gastro-intestinal conditions. Aside from this effect, however, the method may also prove to be of value as a test of the functional capacity of the liver, as judged, for example, by the time required for the appearance of the shadow. It will also permit the addition of new facts to the store of knowledge of the normal physiology of the gall-bladder, especially as regards the question of emptying time, etc.

The theory of the action of the substance, and the theory upon which the work was based, is that, if a substance which is opaque to the Röntgen-ray would be excreted into the gall-bladder by means of the bile, a shadow should be produced which would permit an accurate visualization of the gall-bladder. It is necessary therefore (1) that the functional capacity of the liver be sufficient to permit it to secrete the substance in the bile, (2) that the cystic duct be open to permit the substance to enter the gall-bladder and (3) that the concentrating function of the gall-bladder be sufficiently good to permit con-

centration of the substance in the gall-bladder. Theoretically, therefore, we should expect that the best shadows should be obtained with normal gall-bladders and that a failure to obtain any shadow at all, after following out the technic given below, would almost certainly denote serious pathology of the biliary tract, including the gall-bladder. Our experience has borne out the above prophesy.

FIG. 3.—The same after 29 hours.

We have injected either the calcium or the sodium salt now in fifty-four individual cases, in addition to a large number of experimental animals. In four cases we have failed to obtain any shadow, but in all of these operation revealed very definite cholecystitis. In two of the seven cases there was a complete obstruction of the cystic duct by stone, and in one case there was only a fibrous remnant of a gall-bladder associated with a stone in the common duct. We feel, therefore, that the failure to obtain a definite shadow when the test has been carried out properly is of great value as probably indicating a high grade cholecystitis. We have also been able to diagnose gall-stones in several instances, which have shown themselves to be less opaque areas in contrast with the heavier shadow of the rest of the gall-bladder. Adhe-

FIG. 4.—After 54 hours. The shadow of the gall-bladder has now disappeared.

sions, too, have been recognized by the distortions of the normal contour of the wall of the gall-bladder.

In order to be sure of the results it is very essential that a series of plates shall be made, taken at intervals during a period of about thirty-six hours. The interpretation of the normal gall-bladder is based upon the following findings: Usually at about the fourth to the seventh hour after the injection a faint but definite outline of the gall-bladder appears which is seen to have the contour of the normally shaped organ but to be somewhat larger than normal gall-bladders usually seen at laparotomy. At the end of twenty-four hours the shadow is much more distinct but contracted down to only about one-half of its earlier size. From then on until about the forty-eighth hour the shadow diminishes in size and fades gradually. In cases of simple cholecystitis without stones or adhesions the appearance of the shadow may be delayed and it may be much less dense than the normal. At the present time, however, the interpretation of abnormal shadows is not yet on a secure foundation. A greater experience will be required to work out the interpretations satisfactorily.

FIG. 5.—A gall-bladder showing distortion by adhesions.

Technic.—Injection of the sodium salt is very easily done with a syringe; preferably in two doses one-half hour apart. We have not given it all in one dose and do not know if any deleterious results would follow. Much better results are obtained if the injection is made in the morning between 7.30 and 9.30 A.M., before breakfast.

Crystals of the sodium salt of tetrabromphenolphthalein may be obtained from the Mallinckrodt Chemical Works of Saint Louis. The crystals dissolve very readily, especially upon heating. After filtering, the solution may be sterilized in a boiling water bath for 15 or 20 minutes or in an autoclave. If Mallinckrodt's crystalline sodium salt is used, the solution is prepared by adding about 40 c.c. distilled water to 5½ grams of the sodium salt. It is ready for injection after filtration and sterilization. If the patient weighs less than 120 pounds, the dose should be reduced accordingly; great care

must be exercised not to allow extravasation of the solution into the tissues of the arm. To avoid this possibility the needle should be first inserted into the vein before the syringe containing the material is attached. After completing the injection, it is well also to run a little saline solution through the needle.

Orders for the patient:

1. Omit breakfast.
2. Omit lunch (may have glass of milk).
3. Lie on right side of abdomen or be up walking around.
4. Omit proteins from evening meal.
5. May have water by mouth.
6. Sodium bicarbonate, grs. XL, every three hours for 48 hours.

Röntgenograms are taken at 4, 8, 24 and 32 hours.

The only toxic effects which have so far been discovered with the dose recommended have been temporary and have shown themselves as dizziness, nausea and vomiting. No changes have appeared in the urine. For some unexplained reason male patients are less susceptible to the toxic effects than female patients. Many patients have no disturbance of any kind.

CLOSURE OF ARTIFICIAL ANUS OF EIGHT YEARS' DURATION, WITH SOME REMARKS ON THE QUESTION OF INTESTINAL ANASTOMOSIS*

By Ellsworth Eliot, Jr., M.D.
of New York, N. Y.

Instances of the closure of an artificial anus of more than one years' duration are obviously rare. During that interval no material depreciation in the function of the intestine below the abnormal orifice has taken place. The closure of the opening leads immediately to the complete restoration of colonic action. On the other hand, in cases of long standing, in which the entire bowel contents are discharged through the artificial anus, it is quite reasonable to infer that, owing to the disuse extending over a period of years, the motor, vascular, secretory and nervous apparatus of the intestinal wall may have become so atrophied or otherwise changed that even a partial restoration of their several functions may not take place when the abnormal orifice is closed.

In 1913, the writer was asked to see a patient who had developed an artificial anus following an operation for the relief of an infected appendix. As a fecal fistula, especially where the appendix at the junction with the cæcum happens to be gangrenous, is not a rare post-operative complication and as these fistulæ usually close spontaneously in the course of ten days to several weeks, conservative measures were advised notwithstanding that the entire bowel contents passed through the artificial opening. As the condition remained unchanged at the end of a year, a second consultation was held to discuss the propriety of operation. The patient, about sixty years of age, had for many years been an incurable paranoiac and required the constant attention of two nurses whose testimony, together with that of the attending physician, conclusively showed that the occasional fecal discharge through the abnormal opening did not cause the slightest perceptible annoyance or discomfort and that the usual prophylaxis prevented any irritation of the adjacent skin. Furthermore, the relatively low position of the opening precluded any deterioration in the patient's general condition. While closure would unquestionably have been attempted in an otherwise normal subject, the fact that such a procedure, if successful, would, in the case of an incurable paranoiac, have neither added to her comfort nor have removed the need of constant nursing, seemed to justify a laissez-faire policy. This conclusion was still further strengthened by the surmise that a marked decrease in reparative power, due to the long-continued mental derangement, would, if present, unfavorably affect the chance of successful closure if it did not actually predispose to a fatal post-operative peritonitis.

After several years prolapse appeared. This at first was slight and easily controlled by an overlying pad, although it gradually increased in size. After a time, however, the prolapse, always reducible, became more complete until finally, seven years after the original operation, it formed a voluminous mass, balloon-shaped, bulging over the side of the patient for a distance of at least 12 inches, consisting evidently of the entire ascending colon. When reduced every contrivance failed to prevent its spontaneous return. In this condition it became both a source of annoyance and irritation and its resection seemed justifiable provided that the capacity of the distal gut to function could

* Read before the American Surgical Association, April 17, 1924.

be established with reasonable certainty. Would the delicate nervous, secretory, vascular and muscular mechanisms of the wall of the large intestine, after so many years of inactivity respond to the stimulus of intestinal contents and conduct them by their successful coördination through the entire length of the large intestine to and through the rectal outlet?

Digital examination disclosed a tonic rectal sphincter. Enemata were expelled, the first with a considerable discharge of mucus and fæces, the first in seven years. A small quantity of an analine dye, administered under low pressure in a colon irrigation, appeared at the artificial anus. The operation, as suggested, was therefore performed, the terminal ileum, the entire ascending and several inches of the transverse colon being resected through an incision inclosing the former operative scar and the artificial anus, followed by a lateral anastomosis. The wound was closed in layers around a protruding drain. The patient stood the operation well. The temperature, never above 100, was normal on the fourth day. There was no distention at any time. Peristalsis was quickly reëstablished, gas being passed per rectum at the end of the first 24 hours. The bowels moved naturally on the second day without enema or drip. For the first week the bowel movement were fluid and occurred on an average of once every four hours. The buttocks became considerably excoriated, necessitating constant watching. A small occasional dose of morphine lessened the frequency. The first formed movement occurred one week after operation and afterward the consistency varied. The patient took fluids and soft nourishment with relish. The superficial wound became infected with some sloughing of the aponcurosis. A persistent sinus remained.

During the past four years the patient's condition has been satisfactory, although the post-operative sloughing of the aponeurosis was followed by some bulging in the scar. The function of the bowels is normal.

The type of anastomosis after intestinal excision, presents a most interesting question and a fruitful theme for discussion. In the small intestine, end-to-end anastomosis by suture, the abdomen being closed without drainage, gives excellent results. In the large intestine, a similar procedure may be followed in the sigmoid, of which the mesentery insures proper peritoneal adaptation and protection. Furthermore in this location, a flexible rubber tube inserted into the rectum by an assistant and directed by the operator's hand through the site of anastomosis into the bowel above it, serves to conduct gas and the colon contents through the sutured segment, thereby averting the danger of possible local distention and leakage. In other parts of the large intestine where proper peritoneal covering cannot be secured, the writer prefers a side-to-side anastomosis after closure of the divided intestinal lumina. This seems to afford the greatest protection against subsequent leakage with the formation of a fistula, of which the successful closure is frequently extremely difficult. The writer has had little or no experience with end-to-side anastomosis. Theoretically, after excision of the ileocæcal junction, this method of anastomosis is supposed to restore more satisfactorily than a side-to-side anastomosis the normal condition of this part of the intestine. In informal discussion, however, with those experienced in this method of anastomosis, the writer has gained the impression that both leakage and post-operative obstruction from undue angulation or adhesions are more common than after other methods of anastomosis. Perhaps the standardization of the most desirable method of anastomosis is impossible. The per-

sonal equation may prove, after all, the determining factor, the choice of method depending upon the individual skill and preference of each surgeon.

The writer advocates drainage with a small flexible rubber tube, inclosing a wick of gauze in all cases of anastomosis involving the large intestine. Frequently the wound remains free from infection and the drain is permanently withdrawn at the end of 24 to 72 hours. Occasionally infection appears in the abdominal incision while the intestinal repair is prompt and satisfactory. In a few instances, a small fecal fistula forms, a possibility that fully justifies the use of precautionary drainage. It is scarcely necessary to add that all contact of the drain with the site of anastomosis should be carefully avoided.

While it is both impossible and undesirable to urge any special method of treatment from the experience of a single case, the result, in the present instance at least, has proved sufficiently encouraging to justify an attempt to close an artificial anus even though it be of long standing and complicated by conditions indicative of impaired reparative power.

To Contributors and Subscribers:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS of SURGERY
227-231 S. 6th Street
Philadelphia, Penna.